FORT LEWIS, WASHINGTON

(Including Camp Bonneville, Vancouver Barracks and Yakima Firing Center)

TERRAIN ANALYSIS

PREPARED BY

THE TERRAIN ANALYSIS CENTER

US ARMY ENGINEER TOPOGRAPHIC LABORATORIES

FORT BELVOIR, VIRGINIA 22060

DECEMBER 1978

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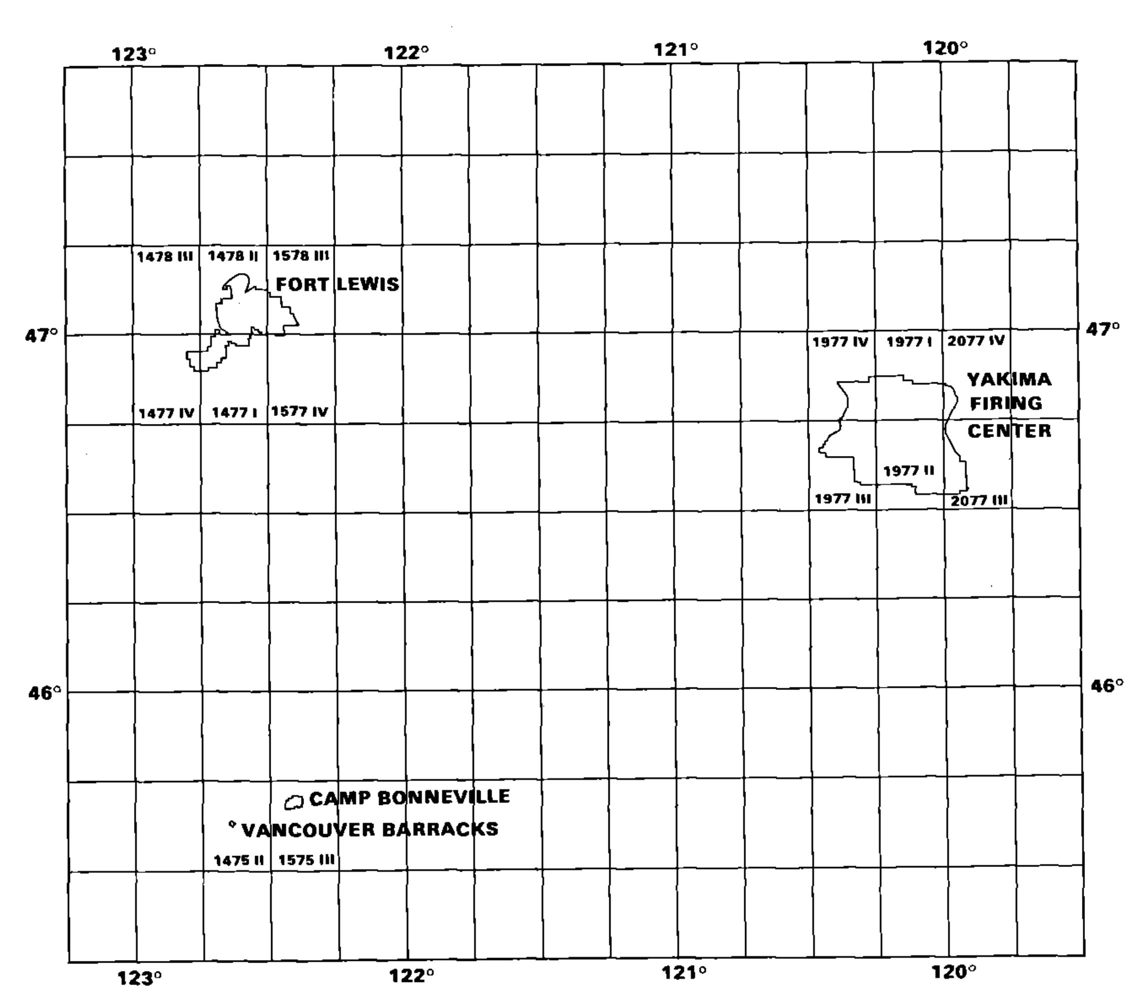
TERRAIN ANALYSIS

TABLE OF CONTENTS

SERIES V791
1:50,000 SHEET INDEX
AND
LOCATION DIAGRAM



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I. INTRODUCTION

BACKGROUND

This terrain analysis of Fort Lewis and its sub-installations of Camp Bonneville, Vancouver Barracks and the Yakima Firing Center was prepared by the Terrain Analysis Center (TAC), US Army Engineer Topographic Laboratories, in response to a requirement of the US Army Forces Command (FORSCOM). The requirement for studies of 17 installations including Fort Lewis was stated in FORSCOM messages P241854Z and R0919002 dated October 1975 and July 1976, from the Commander, FORSCOM, to the Office Chief of Engineers (OCE), Department of the Army, Subject: "Terrain Analysis of Selected FORSCOM Installations." Responsibility for management and supervision of the program, developed in response to the FORSCOM requirement, was assigned to TAC by OCE. Analytical and cartographic specifications for the studies were developed by TAC, coordinated with OCE and concurred in by FORSCOM. Cartographic and printing support for the Fort Lewis study was provided by the Defense Mapping Agency Topographic Center.

PURPOSE

In stating the requirement for terrain analyses of selected installations, FORSCOM indicated that the purpose of the program is to assist military planners in future stationing decisions. To achieve this purpose, planners must obtain an appreciation of the on-post terrain that includes among many other things, knowledge of the suitability for conducting field training exercises involving maneuverability of troops and military vehicles. The degree of maneuverability that can be achieved is a function of several terrain factors including slope, surface configuration, soils, vegetative cover, and surface drainage, all of which are treated in the studies.

Planners concerned with troop stationing also need certain off-post information such as statistics on housing, schools, hospitals, and public utilities in urban areas near installations, as well as pertinent data on airfields and ports in the vicinity. These "details" are also treated in the studies.

Since the program under which this study was prepared is intended to serve troop stationing requirements, the support provided by the program to environmental requirements is only incidental. While some of the information contained in the studies may be useful as environmental base line data, the studies are by no means complete environmental inventories of the kind required in support of environmental impact assessments.

SCOPE

In scope, the terrain analysis is a compendium of available data on the pertinent natural and manmade features of the reservation and an evaluation of their effects on tactical military operations. The program does not include basic research to fill gaps in these data although some short-term field investigations were performed to obtain ground truth and a general overall appreciation of terrain elements. Therefore, the scope of the analysis is limited primarily to those factors which have been documented by other authorities and to the results of analysis and evaluation of those factors by senior terrain analysts for topics such as cross-country movement, cover and concealment, and water resources.

The terrain analysis preparation process has necessarily involved analytical judgment in the selection of pertinent source data, resolution of data conflicts, recognition of interrelationships not previously made explicit, and the application of remote sensing to update certain critical, time-variant data such as vegetative cover and manmade features including roads, airfields, and facilities constructed outside of the cantonment areas.

LIMITATIONS

The study naturally reflects limitations in the quality, amount, and currency of the source data on which it is based. Numerous field interviews and selective use of remote sensing were employed in an effort to assure presentation of the latest and best information. Within the relatively complex topical scope of the analysis, however, there are a number of aspects on which source data have not been generated with the focus or recency desired to meet objectives fully. As noted under Scope, the study effort was not designed to include basic research as a means of filling gaps in data.

By design, the presentation is cast at a level of data coverage consistent with stated objectives. Users interested in deeper pursuit of data are referred to the List of Sources in the back of the study.

PRESENTATION

The study consists of terrain topics presented in both textual and graphic format. The topical data are overprinted on base maps preceded by text which is tabular for most part and which is keyed to accompanying map presentations. For each topic, textual data are arranged in the following sequence: Fort Lewis, Camp Bonneville and Yakima Firing Center. The treatment of Climate for all installations and Vegetation for the Yakima Firing Center include text only. Data on Vancouver Barracks are limited to coverage presented under Urban Areas (Cantonments).

The primary scale of treatment is 1:50,000. Base maps were developed from individual 1:50,000-scale composite map sheets of Fort Lewis and the Yakima Firing Center. Camp Bonneville coverage is provided by a 1:50,000-scale inset on the map of Fort Lewis. Necessary exceptions to the basic 1:50,000-scale of treatment have been made for Cantonments, Off-Post Features and Engineering Geology, Yakima Firing Center. Cantonment graphics are at scales much larger than 1:50,000 in order that selected structures and functional areas might be clearly identified. Off-Post Features are shown at a scale of 1:1,000,000. Limited source material enabled presentation of Engineering Geology for only part of the Yakima Firing Center at a scale smaller than 1:50,000.

STUDY AREA (See Location Map below)

Fort Lewis:

Fort Lewis is located approximately 10 kilometers (six miles) south and slightly west of the city of Tacoma, Washington. It is situated on a glacial outwash plain bordering Puget Sound. Flat to Gently rolling terrain with isolated mounds rising sharply above their surroundings, glacial lakes of various sizes up to 486 hectares (1,200 acres), extensive stands of Douglas-fir and large but less extensive prairie grass communities characterize the landscape. Except for the Nisqually River, surface drainage channels are poorly defined or are non-existent. Climate is mild, distinguished by warm, generally dry summers and mild, wet winters.

Reservation boundaries encompass an irregularly shaped area of approximately 34,804 hectares (86,000 acres). The area is configured, hourglass style, with its longest axis extending generally northeast to southwest. The Nisqually River, crossing the reservation at its narrowest point, divides the area into northeastern and southwestern sectors. The northeastern sector is the larger of the two areas. The reservation is easily accessible by state and Interstate roads, by rail and by air. The closest deep-water port is at Tacoma.

Camp Bonneville:

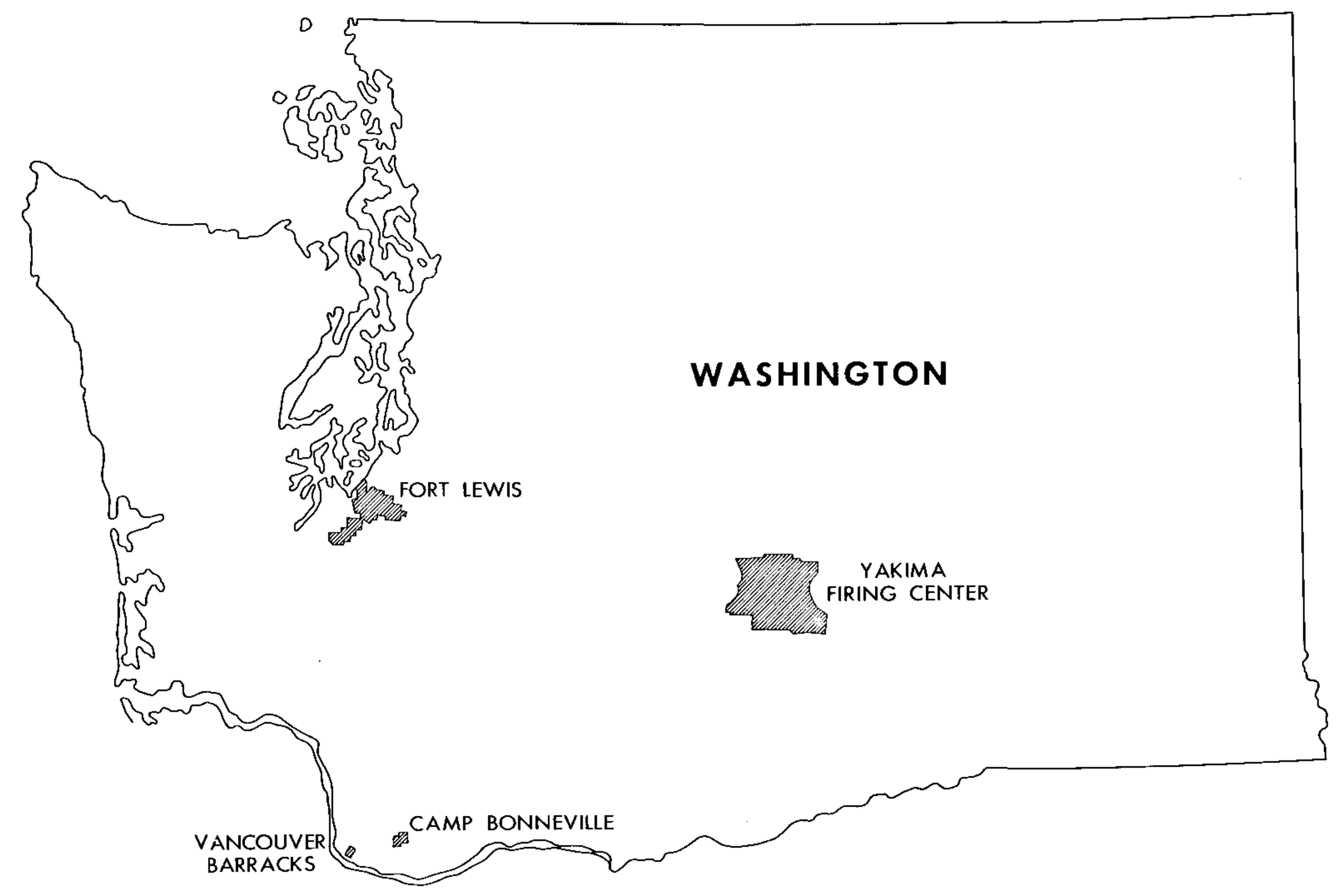
Camp Bonneville, a sub-installation of Fort Lewis, is located in the western foothills of the Cascade Mountains in southwestern Washington approximately 23 kilometers (14 miles) east of Vancouver and 10 kilometers (six miles) north of Camas. The air distance between Fort Lewis and Camp Bonneville is approximately 153 kilometers (95 miles). The camp contains 1,538 hectares (3,800 acres) situated in the upper valley of Lackamas Creek and is utilized solely for reserve training purposes. Climatically, the area is classified as temperate marine. Locally, differences in elevations cause some slight variations in weather conditions. Terrain is predominantly hilly with a cover primarily of Douglas-fir. Hill slopes are largely 8 to 30%. Grasslands, having slopes of 3 to 8%, are maintained in the Lackamas Creek valley for field maneuvers.

Yakima Firing Center:

The Yakima Firing Center is located on the Columbia Plateau in eastern Washington approximately 160 kilometers (100 miles) southeast of Fort Lewis. Installation boundaries encompass approximately 106,436 hectares (263,000 acres) of semi-arid land extending from the City of Yakima some 39 kilometers (24 miles) eastward to the Columbia River. The semi-arid landscape is dominated by three roughly parallel ridges that angle across the installation from northwest to southeast. The ridges are heavily eroded, particularly in the eastern portion of the base where numerous steep sided valleys and canyons exist. Vegetation on the installation is typically semi-arid, primarily consisting of sagebrush and bunchgrass with some scattered trees along valley bottom drainageways. The western two-thirds of the reservation is drained westward into the Yakima River by Squaw and Selah Creeks, the eastern third eastward into the Columbia River by Hanson Creek, Cold Creek and other shorter drainage channels. The climate of the Center is characteristically dry year-round with cool to cold winters and warm summers.

Vancouver Barracks:

Vancouver Barracks, a 25 hectare (62-acre) sub-installation of Fort Lewis, is located in the south central section of the City of Vancouver, Washington. It is used for maintaining, supporting and training US Army Reserve and National Guard units of the Oregon and Washington area. Terrain ranges from 30 to 104 feet above sea level, is level from east to west, and slopes gradually from north to south toward the Columbia River. The post is easily accessible by road, rail and air. The road distance to Camp Bonneville is approximately 23 kilometers (14 miles).



II. DESCRIPTION AND MILITARY ASPECTS OF TERRAIN

A. SURFACE CONFIGURATION

FORT LEWIS

Fort Lewis is located on a glacial outwash plain within the Pacific Border Physiographic Province. The terrain is flat to rolling with isolated mounds rising sharply above the general elevation of the glaciated plain. A major stream, the Nisqually River, and its deeply eroded floodplain divides the reservation into a northeastern sector, and a smaller southwestern extension. Surface drainage channels are poorly defined and on most of Fort Lewis are non-existent, a condition attributable to highly permeable surface material. There are more than 30 lakes (glacial kettles), varying in size from 0.4 to 454 hectares (1 to 1123 acres). Landform type distribution is shown on the accompanying Surface Configuration/Surface Drainage map of Fort Lewis. Additional details are provided in Table A-1, below.

TABLE A-1

MAP UNIT	LANDFORM TYPE	LANDFORM DESCRIPTION AND DISTRIBUTION	ELEVATIONS
1.	Low Plains	Flat to gently rolling surfaces. Low plains make up the largest terrain unit. This unit includes the 91st Division Prairie and the entire eastern portion of the reservation. The other two significant areas are found in the southwestern extension of the reservation in the area south of the Nisqually Indian Reservation and Weir Prairie. Isolated, mounded glacial deposits rise 30 to 75 m (98 to 246 ft) above the general surface level. Few stream channels found in this map unit; numerous water-filled depressions scattered throughout the low plains. Local relief is largely between 25 and 45 m (82 and 148 ft). Lowest local relief found in the cantonment area, just west of American Lake. Highest local relief is located within Weir Prairie. Slopes are generally between 0 to 3%. Cantonment area falls entirely within this terrain unit.	Most of the low plains are between 65 and 150 m (213 and 492 ft) above sea level. Lowest elevation, 60 m (197 ft), along Nisqually River Escarpment. Highest elevation, 175 m (574 ft), near Weir Prairie.
2.	High Plains	Moderately rolling plains with isolated glacial mounds. All five areas are situated in the west and southwest portion of the installation. Of the two largest areas in this terrain unit, one is located in the Rainier Training Area and the other immediately north of the 91st Division Prairie. Of the three smaller areas, one is located around Lewis Lake, the second around Miller Hill, and the third between Puget Sound and the Northern edge of the cantonment area. Local relief generally from 50 to 60 m (164 to 197 ft). Lowest local relief is in the vicinity of Goodman Hill and Sawmill Lake. Highest local relief is found southwest of Cat Lake in the southwestern sector of the reservation. Slopes are largely between 0 and 15%.	Most of the high plains are between 75 and 125 m (246 and 410 ft), above sea level. Lowest elevation, 60 m (197 ft), along the top of the escarpment bordering Puget Sound in the northwest. Highest elevation, 195 m (640 ft), in the extreme southwest corner of the reservation.
	Escarpments	Steep escarpment borders Puget Sound and the lower floodplain of the Nisqually River. Escarpment is located along western edge of the reservation. Local relief generally 12 to 60 m (39 to 197 ft). Lowest local relief near Puget Sound and highest local relief located between Nisqually River and Nisqually Lake. Slopes generally exceed 30%. The Nisqually River floodplain, about one kilometer in width, is a flat to gently rolling alluvial surface separated from adjacent plains by steep escarpments.	Most of the escarpment is between sea level and 60 m (197 ft).

CAMP BONNEVILLE

Camp Bonneville is situated in the unglaciated western foothills of the Cascade Mountains in southwestern Washington. The installation lies in the upper valley of Lackamas Creek and is bordered by hills on the north, east, and southeast. The entire camp is drained by Lackamas Creek and its tributaries. The distribution of landform types are shown on the Camp Bonneville inset on the Surface Configuration Map of Fort Lewis. Table A-2 provides additional details.

TABLE A-2

MAP UNIT	LANDFORM TYPE	LANDFORM DESCRIPTION AND DISTRIBUTION	ELEVATIONS
1.	Low Plains	Flat to rolling surfaces predominate. The single low plain occupies the upper valley of Lackamas Creek and is found in the southwest part of the installation. Local relief is generally 25 to 35 m (82 to 115 ft). Lowest local relief adjacent to Lackamas Creek and the highest local relief in the Munsell Hill area. Slopes are largely between 3 and 8%.	Most of the plain is between 90 and 120 m (295 and 394 ft) above sea level. Lowest elevation, 88 m (289 ft), found along Lackamas Creek. Highest elevation, 150 m (492 ft), found on top of Munsell Hill.
2.	Low Hills	Rounded hills predominate. The hills occupy the northwest area of the base west of the North Fork of the Lackamas Creek. Local relief is generally 190 to 230 m (623 to 754 ft). Lowest local relief near the junction of Lackamas Creek and North Fork. Highest local relief on the upper slopes of Little Elkhorn. Slopes are largely between 8 and 30%.	Most of these hills are between 125 and 185 m (410 and 607 ft) above sea level. Lowest elevation, 120 m (394 ft), found near the mouth of North Fork. Highest elevation, 190 m (623 ft), found near the top of Little Elkhorn.
3.	High Hills	Steep, rounded hills predominate. Hills found in the east and southeast portion of the installation. Local relief is generally 300 to 350 m (984 to 1148 ft). Lowest local relief near the mouth of East Fork. Highest local relief near Livingston Mountain. Slopes are largely between 15 and 30%.	Most of these hills are between 125 and 450 m (410 and 1476 ft) above sea level. Lowest elevation, 120 m (394 ft), found near the mouth of the East Fork. Highest elevation, 500 m (1640 ft), found on the upper slopes of Livingston Mountain.

YAKIMA FIRING CENTER

Yakima Firing Center is located on the western edge of the Columbia Plateau and is bounded by the Yakima River on the west, the Columbia River on the east, Saddle Mountains on the north, and Rattlesnake Hills on the south. The dominant topographic features of the Firing Center are the three parallel basaltic ridges—Saddle Mountains, Umtanum Ridge, and Yakima Ridge—crossing the reservation in a northwest-southeast direction. Water and wind erosion have removed several feet of the soft upper basalt layers from the ridges and have deposited sand and gravel in the broader valleys. Stream erosion has cut steep-sided valleys and deep canyons, especially in the eastern portion of the base. The western two-thirds of the reservation is drained by Squaw and Selah Creeks which flow westward into the Yakima River. Hanson Creek, Cold Creek and several other eastward flowing streams drain into the Columbia River. The distribution of landform types within the Center area is shown on the accompanying Surface Configuration/Surface Drainage map. Additional details are provided in Table A-3, below.

TABLE A-3

MAP UNIT	LANDFORM TYPE	LANDFORM DESCRIPTION AND DISTRIBUTION	ELEVATIONS
1.	Low Plains	Flat to gently rolling surfaces. The seven low plains areas are individually small in size, and combined, constitute a minor portion of the reservation. Two linear areas occur in the northeast corner adjoining the Columbia River, one area is located in the extreme northwest of the reservation, and the other four areas are scattered in the Selah Creek Basin area. The cantonment area is situated within the low plain in the extreme western portion of the reservation. Local relief is largely 25 to 35 m (82 to 115 ft). Lowest local relief is found along the Columbia River. Highest local relief is located in the northwest corner of the reservation. Slopes are generally between 0 and 8%.	Most of the low plains are between 395 and 625 m (1296 and 2050 ft) above sea level. Lowest elevation, 155 m (508 ft), is located along the Columbia River. Highest elevation, 675 m (2214 ft), is in middle Selah Creek.
2.	High Plains	Moderately rolling plains with basaltic sand and gravel deposits throughout. Both areas are situated in the western portion of the reservation in the Selah Creek and Squaw Creek drainage basins. Local relief is generally from 55 to 145 m (180 to 476 ft). Lowest local relief is found on Selah Creek just north of, and between, bench marks 2494 and 2371. Both bench marks are situated along Cold Creek Road. Highest local relief is located south of Selah Springs area. Slopes are mainly between 3 and 15%.	Most of the high plains are between 610 and 745 m (2001 and 2444 ft) above sea level. Lowest elevation, 430 m (1410 ft), is located east of the cantonment area at the boundary separating low and high plains. Highest elevation, 950 m (3116 ft), is near the head of Selah Creek.
3.	Low Hills	Predominantly rounded hills. There are three low hills areas. The largest is located in the northeast part of the reservation. This large area and its two northwest extensions include Alkali and other smaller canyons. The smallest low hills area is situated along the southwest edge of the reservation. The third low hills area extends across the entire southern edge of the reservation with a small extension taking in Cold Creek. Local relief is largely 155 to 275 m (508 to 902 ft). Lowest local relief is near the southeastern edge of the reservation. Highest local relief is in the northeastern corner of the reservation. Slopes are largely between 8 and 30%.	Most of the low hills are between 550 and 855 m (1804 and 2804 ft) above sea level. Lowest elevation, 155 m (508 ft), is found along the Columbia River. Highest elevation, 1000 m (3280 ft), is found near the center of the reservation.
4.	High Hills	Steep rounded hills. There is one small area of high hills in the north, near Saddle Mountains, and there are two other areas of high hills located along Umtanum Ridge and Yakima Ridge. Local relief is largely 300 to 410 m (984 to 1345 ft). Lowest local relief is on the south slope of Umtanum Ridge. Highest local relief is on the north slope of Umtanum Ridge. Slopes are largely between 15 and 45%.	Most of the high hills are between 855 and 1220 m (2804 and 4002 ft) above sea level. Lowest elevation, 600 m (1968 ft), is found in the eastern portion of Umtanum Ridge. Highest elevation, 1277 m (4189 ft), is found on Hog Ranch Buttes.

YAKIMA FIRING CENTER

TABLE A-3 (continued)

MAP UNIT	LANDFORM TYPE	LANDFORM DESCRIPTION AND DISTRIBUTION	ELEVATIONS
5.	Mountains	Rounded mountains. There is one small mountain area on the eastern edge of the reservation near Priest Rapids. Local relief is largely 660 to 715 m (2165 to 2346 ft). These figures also represent the lowest and highest local relief for this area. Slopes are largely between 45 and 60%.	Most of the mountain area is between 195 and 850 m (640 and 2788 ft) above sea level. Lowest elevation, 195 m (640 ft), is located northwest of Priest Rapids Dam. Highest elevation, 878 m (2881 ft), is near southwest portion of mountain area.
	Escarpments	Three steep escarpments. Two escarpments border canyon areas, one in the west near Selah Creek and the other in the east near Corral Canyon. The third escarpment is situated along the Columbia River in the northeast corner of the reservation. Local relief is generally 60 to 120 m (197 to 394 ft). Lowest local relief is in upper Corral Canyon. Highest local relief is near the Columbia River. Slopes are generally from 45 to 60%.	Most of the escarpments are between 180 and 520 m (590 and 1706 ft) above sea level. Lowest elevation, 155 m (508 ft), is along the Columbia River. Highest elevation, 670 m (2200 ft), is at the east end of Saddle Mountains.

B. SURFACE DRAINAGE

FORT LEWIS

The majority of the surface drainage features of Fort Lewis feed into the westward flowing Muck Creek and the northwestward flowing Nisqually River. There are several minor streams flowing northward into Spanaway Lake, American Lake and directly into Puget Sound and one that flows westward into Spurgeon Creek. Numbered features in the tables below can be located on the Surface Configuration/Surface Drainage map.

Stream discharge is not measured on Fort Lewis. The nearest streamflow gaging station to the reservation is on the Nisqually River above Powell Creek, near McKenna and 20.6 kilometers (12.8 miles) upstream of the boundary. A crest-stage partial-record station is located on Muck Creek at Roy, just outside the reservation. The annual maximum discharge reading at this station for the 1974 water year was 13.13 cubic meters per second (464 cubic feet per second) taken on 18 January 1974 and the gage height was 1.27 meters (4.17 feet). Discharge records from the Nisqually River station indicate the high water period on that stream is from about December through February and the low water period is from about July through October. The high water period on other reservation streams is about January and February, while the low period appears to be from May through November.

There is a distinct difference in high and low water periods between the Nisqually River and other reservation streams. Early winter rainfall in the mountains to the east causes the onset of the high water period to be about a month earlier on the Nisqually River than on other local streams. Melt water from the snow pack in the Mount Rainier area delays the onset of the low water period on the Nisqually River by supplying additional water particularly in May and June. During the summer dry period, when some Fort Lewis lakes and streams are drying up, Nisqually River flow is fortified by glacier melt waters. There are several upstream dams that also regulate its flow.

Because of the high porosity of reservation soils, a great deal of the rainfall seeps directly into the ground. The groundwater level is usually at varying depths beneath the land surface, but in the case of permanent lakes or marshes, it is at the surface. The high soil porosity and seasonal rainfall differences can combine to cause considerable fluctuations in groundwater level. During the summer months when the groundwater is at its lowest level, some lakes may be reduced to marshes and marshes may dry up.

High soil porosity also helps to reduce the flood problem during the rainy season. There are, however, occasional winter floods across the Nisqually River bottom. The river changes channels and moves a great deal of silt and gravel, but human activity is kept to a minimum here, so very little property damage is sustained. Muck Creek may fill its banks, but seldom floods. All other streams are minor and cause no serious problems.

Drainage features rarely freeze during winter. The temperature is below freezing at times, but it is seldom long enough to cause more than the formation of a thin sheet of ice on water surfaces.

There are numerous beaver ponds in the Nisqually River Valley, particularly in the area of grid coordinate 258068. They are located mostly in side and spring channels and range in size from very small to about 1.6 hectares (4 acres). Ponds may be as much as 3 meters (10 feet) deep, but probably average about 1.2 meters (4 feet) and bottoms are usually muddy and silty. A few beaver ponds are also scattered in the Rainier Training Area.

TABLE B-1

DRAINAGE CHARACTERISTICS

DRAINAGE CATEGORIES	GENERAL	REGIME	WIDTHS	DEPTHS	VELOCITY AND DISCHARGE	BANKS	BOTTOMS
Watercourses							
Nisqually River	Major perennial stream flows through a fairly narrow, often steep-sided valley to become a meandering stream through a moderately wide, steep-sided valley. Stream flows northwesterly and contains numerous beaver ponds in stream valley, particularly along lower reaches and some rapids in upper reaches.	High water, Dec thru Feb. Low water, Jul thru Oct.	Generally from about 46 m (150 ft) to about 76 m (250 ft).	About 0.5 m (1.5 ft) to 1.5 m (5 ft) at normal water and 3 m (10 ft) to 6 m (20 ft) in floods. The maximum recorded height at the gage near McKenna is 3.4 m (11.14 ft) on 16 Jan 1974.	Fairly high velocity especially in upper reaches. Discharge controlled by upstream dams. At gage near McKenna, maximum discharge for period of record is 657 m^3/sec (23,200 ft^3/sec) on 16 Jan 1974. Minimum discharge is 2.41 m^3/sec (85 ft^3/sec) on 19 Oct 1945. Average discharge is 52 m^3/sec (1848 ft^3/sec). (See Table B-5 for mean monthly discharge).	Slit and gravel. Bank heights varied, but average about 1.8 m (6 ft) and steep. Where banks coincide with valley walls they may become high bluffs up to about 60 m (200 ft).	Mostly gravel and silt. Some cobble in upper reaches. Gradient less than 1% in lower and mid reaches and 1–2% in upper reaches.
Muck Creek	Mostly perennial stream flows slowly over wide prairie to become fast-flowing stream through narrow steep-sided valley. Flows westerly to the Nisqually River.	High water, Jan and Feb. Low water, May thru Nov.	About 3 m (10 ft) to about 9 m (30 ft).	About 0.3 m (1 ft) in normal water to about 1.8 m (6 ft) in floods.	Slow flowing in upper reaches, but becoming very fast flowing as stream drops into Nisqually River Valley. Discharge may reach 20 m^3/sec (700 ft^3/sec) in flood, while portions occasionally dry up in summer.	Mostly gravelly sandy loam. Marshy areas around Chambers Lake are silt loam. About 0.6–0.9 m (2–3 ft) high and of moderate steepness.	Mostly gravel. Gradient 1–2% for about 2 miles above mouth and less than 1% above that.
Other streams	Small, mostly perennial streams; generally spring fed and often draining marshy areas.	High water, Jan and Feb. Low water, May thru Nov.	Up to about 6 m (20 ft).	Most streams about 0.3–0.6 m (1-2 ft). Murray Creek excavated to about 0.9 m (3 ft).	Fairly slow-flowing streams. Average discharges between about 0.1 and 0.6 m^3/sec (5 and 20 ft^3/sec). South Creek dries up in summer.	Mostly gravelly sandy loam on Lacomas and South Creeks. Others generally silt loam. Usually less than 0.6 m (2 ft) high.	Mostly gravel in Lacomas and South Creeks. Others generally silty and mucky. Gradients almost entirely less than 1%.
Standing Bodies of Water (see Lakes and Reservoirs table below)							
Wet Areas (see Swamps and Marshes table below)							

TABLE B-2

LAKES AND RESERVOIRS

MAP NUMBER	NAME	GRID COORDINATES	APPROXIMATE HECTARES (ACRES)	APPROXIMATE MAXIMUM DEPTH METERS (FEET)	REMARKS
1	American Lake	320180	470 (1162)	27.4 (90)	Bottom quite gravelly, 151 hectares (374 acres) on Fort Lewis.
2	American Lake Pond	311170	1 (2.5)	2.1 (7)	Dry in years of low precipitation.
3	Bauman Lake	274095	0.8 (2)	2.4 (8)	Goes dry occasionally.
4	Cat Lake	240016	1.2 (3)	7 (23)	Steep banks.
5	Chambers Lake	360075	40.5 (100)	2.4 (8)	Reservoir. Earth fill dam with concrete spillway and concrete fishway.
6	Dailman Lake	367074	12.1 (30)	1.8 (6)	Dry in years of low precipitation.
7	Elias Lake	370136	0.8 (2)	Shallow	Partially covered with shrubs. Dry in years of low precipitation.
8	Farnsworth Lake	282071	2.8 (7)	Shallow	
9	Fiander Lake	238994	12.1 (30)	2.4 (8)	
10	Golf Course Lake	264150	0.6 (1.5)		
11	Hamilton Lake	366070	6.5 (16)	Shallow	
12	Hillhurst Lake	379157	1.6 (4)	Shallow	Partially covered with shrubs.
13	Hodge Lake	258151	1.6 (4)	1.8 (6)	Dry in years of extremely low precipitation.
14	Jolly Lake	240021	11 (27)	Shallow	A dam was constructed but is not sealed.
15	Lewis Lake	329037	22 (54)	2.7 (9)	Created by a road fill.
16	Lynn Lake	353168	1 (2.5)	0.8 (2.5)	
17	Nisqually Lake	282080	40.5 (100)	3.7 (12)	
18	No Name Lake	210982	1.2 (3)	3.4 (11)	
19	Rebeckah Lake	212988	0.4 (1)	Shallow	
20	Sawmill Lake	274130	1.2 (3)	Shallow	
21	Sears Lake	315180	1.6 (4)	3.2 (10.5)	
22	Sequalitchew Lake	300175	32 (80)	5.2 (17)	
23	Shaver Lake	370086	2.4 (6)	Shallow	Extensive grass cover
24	Watkins Lakes	378092	2 (5)	Shallow	
25	Wrights Lake	303133	4.5 (11)	2.1 (7)	

TABLE B-3

SWAMPS AND MARSHES*

MAP NUMBER	NAME	GRID COORDINATES	APPROXIMATE HECTARES (ACRES)	APPROXIMATE MAXIMUM DEPTH METERS (FEET)	REMARKS
1	Brandenburg Marsh	343059	0.8 (2)	Shallow	Considerable coverage in shrubs.
2	Bill Lake	379135	2.4 (6)	Shallow	Considerable coverage in shrubs and grasses.
3	Clay pits	428069	1.6 (4)	1.8 (6)	Connected excavated pits.
4	Crane Lake	385142	12.1 (30)	Shallow	Considerable coverage in shrubs and grasses.
5	Deschuttes Marsh	181954	2.2 (5.5)	1.2 (4)	Beaver pond.
6	DeBalon Lake	372125	0.4 (1)	Shallow	Partially covered with shrubs. Dry in years of low precipitation.
7	Elliot Marsh	314190		Shallow	
8	Farrell Marsh	304227		Very shallow	Dry in years of low precipitation.
9	Foot Lake	388161	6.5 (16)	Shallow	Partially covered with shrubs.
10	Hamer Marsh	294171	44.5 (110)	Shallow	Has drainage ditches. Covered with grasses and shrubs.
11	Halverson Marsh	348064	9.7 (24)	4.3 (14)	Many spring holes.
12	Hardhack Marsh	412127	46.5 (115)	Very Shallow	Covered with shrubs and gasses.
13	Johnson Marsh	382104	61.9 (153)	1.8 (6)	Will become reservoir. New 4 ft. earth fill dam with concrete spillway and concrete fishway just completed. Dam location estimated on map.
14	Joseph Marsh	394134	10.1 (25)	Shallow	Considerable coverage in shrubs and grasses.
15	Kennedy Marsh	339159		Shallow	
16	Kinsey Marsh	370167		Shallow	Considerable coverage in shrubs.
17	McKay Marsh	294165	16.2 (40)	Shallow	Some shrub coverage.
18	Mondress Lake	374182	6.1 (15)	Shallow	Covered with grasses and shrubs.
19	Oxbow Lake	283034	1.2 (3)	1.8 (6)	Beaver pond with some grass and shrub cover.
20	Park Marsh	319196		Shallow	Partially overgrown with bush.
21	Pipeline Marsh	175972		Shallow	Has an excavated channel and is covered with shrubs.
22	Rainier Marsh	246049	1 (2.5)	1.4 (4.5)	
23	Ranger Lake	164977	6.1 (15)		Dry most of year.
24	Saul Lake	369127	2.8 (7)	Shallow	Considerable vegetative cover.
25	Shannon Marsh	293127	1.6 (4)	2.4 (8)	Five individual ponds in summer; one deep channel.
26	Spanaway Marsh	411145	151 (373)	Shallow	Considerable coverage in shrubs.
27	State Lake	239008	4.5 (11)	Shallow	Considerable coverage in grasses.
28	Vietnam Village Marsh	399121	16.2 (40)	2.7 (9)	Some open water in peat excavation pits.

*Includes some named lakes which are shallow and contain considerable vegetation. Some small and unnamed swamps and marshes not listed.

FORT LEWIS

TABLE B-4

FORDS*

MAP NUMBER	GRID COORDINATES	APPROXIMATE DEPTH METERS (FEET)	APPROXIMATE LENGTH METERS (FEET)	APPROXIMATE WIDTH METERS (FEET)	BOTTOM COMPOSITION	APPROACHES COMPOSITION AND CONDITION	REMARKS
1	432063	0.3 (1)	10.3 (34)	5.1 (17)	Gravel	Gravelly sandy loam. Easy	Nos. 1 thru 16: Vehicular fords.
2	433063	0.3 (1)	15.8 (52)	7.9 (26)	Gravel	Gravelly sandy loam. Easy	High water, Jan and Feb. Ford-
3	436067	0.3 (1)	14.6 (48)	10.6 (35)	Gravel	Gravelly sandy loam. Easy	ing conditions generally poor.
4	424070	0.3 (1)	9.7 (32)	5.0 (16)	Gravel	Gravelly sandy loam. Easy	Low water, May thru Nov. Ford-
5	426074	0.3 (1)	16.1 (53)	5.0 (16)	Gravel	Gravelly sandy loam. Easy	ing conditions generally good.
6	422085	0.3 (1)	19.2 (63)	6.7 (22)	Gravel	Gravelly sandy loam. Easy	No. 17: Tank ford. High water
7	418086	0.3 (1)	17.1 (56)	8.8 (29)	Gravel	Gravelly sandy loam. Easy	Dec thru Feb. Fording condi-
8	415085	0.3 (1)	8.2 (27)	5.0 (16)	Gravel	Gravelly sandy loam. Easy	tions generally poor. Low water
9	415085	0.3 (1)	11.8 (39)	5.0 (16)	Gravel	Gravelly sandy loam. Easy	Jul thru Oct. Fording conditions
10	411083	0.3 (1)	12.8 (42)	5.0 (16)	Gravel	Gravelly sandy loam. Easy	generally good.
11	396087	0.3 (1)	13.4 (44)	5.0 (16)	Gravel	Gravelly sandy loam. Easy	
12	388085	0.3 (1)	8.5 (28)	5.0 (16)	Gravel	Gravelly sandy loam. Easy	
13	383088	0.3 (1)	12.1 (40)	5.0 (16)	Gravel	Gravelly sandy loam. Easy	
14	377092	0.3 (1)	7.3 (24)	3.0 (10)	Gravel and Silt	Silt loam. Easy	
15	325056	0.3 (1)	11.5 (38)	3.6 (12)	Gravel	Gravelly sandy loam. Easy	
16	315056	0.3 (1)	5.1 (17)	3.0 (10)	Gravel	Gravelly sandy loam. Easy	
17	279034	0.91 (3)	62.4 (205)	5.0 (16)	Gravel and Silt	Silty clay. Easy	

*Fords plotted on the map are commonly used sites. There are many other places not plotted on the map along Muck Creek and other small streams that may be used as fords during low water. Widths and depths calculated at average low water. Stream velocities not available. There are times in late summer when stream beds at some sites may become dry.

TABLE B-5

MEAN MONTHLY DISCHARGE

MONTH	NISQUALLY RIVER NEAR MCKENNA, WA* (AUG 1941–JUN 1963, MAR 1969–APR 1976) M^3/SEC (FT^3/SEC)
January	78.14 (2761)
February	76.95 (2719)
March	64.61 (2283)
April	57.31 (2025)
May	54.82 (1937)
June	42.53 (1503)
July	28.67 (1013)
August	21.22 (750)
September	24.96 (882)
October	38.94 (1376)
November	60.42 (2135)
December	78.59 (2777)

*Not in area covered by map.

CAMP BONNEVILLE

Camp Bonneville is drained entirely by the southwesterly flowing Lackamas Creek and its tributaries. The soils are mainly clay and nonporous, so there is considerable runoff after each storm and occasional minor flooding of Lackamas Creek. The stream sometimes leaves its banks and inundates the adjacent floodplain, but not enough to cause appreciable damage. There are no streamflow gaging stations in or around the camp. Numbered features in the tables below can be located on the Surface Configuration/Surface Drainage Map.

TABLE B-6
DRAINAGE CHARACTERISTICS

DRAINAGE CATEGORIES	GENERAL	REGIME	WIDTHS	DEPTHS	VELOCITY AND DISCHARGE	BANKS	BOTTOMS
Watercourses							
Lackamas Creek	Perennial stream flows through a fairly wide valley in a southwesterly direction.	High water, Dec thru Feb. Low water, May to Nov.	From about 3 m(10 ft) in north to about 11 m(35 ft) in the south.	About 0.3 m (1 ft) or more.	Moderate velocity stream. Discharge probably averages about 0.4 m^3/sec (15 ft^3/sec).	Mostly clay with clay loam in upper portions. Average about 1.2 m (4 ft) and steep.	Mostly gravel with silt. Gradient less than 1%.
Other streams	Small, mostly perennial streams flow through narrow headwater valleys in a general westerly direction. Includes forks of Lackamas Creek.	High water, Dec thru Feb. Low water, May to Nov.	Up to about 3 m (10 ft).	Averages less than 0.3 m (1 ft).	Fairly high velocity. Discharge probably averages about 0.3 m^3/sec (5 ft^3/sec) or less. Buck Creek dries up in summer.	Mostly gravelly clay loam. Average about 0.6 m (2 ft) or less.	Mostly gravel with bedrock occasionally exposed. Gradients vary from about 5 to 10%.
Standing Bodies of Water (see Lakes and Reservoirs table below)							
Wet Areas (see Swamps and Marshes table below)							

TABLE B-7
LAKES AND RESERVOIRS

MAP NUMBER	NAME	GRID COORDINATES	APPROXIMATE HECTARES (ACRES)	APPROXIMATE MAXIMUM DEPTH METERS (FEET)	REMARKS
1	Recreation Area Pond	456598	0.4 (1)	2.1 (7)	Reservoir. Earth fill dam with wooden supports and concrete spillway.
2	Pond on North Fork	466606	0.2 (0.5)	1.5 (5)	Reservoir. Earth fill dam with vertical riser. Pond is fed by ditch from stream which flows alongside.

TABLE B-8
SWAMPS AND MARSHES

MAP NUMBER	NAME	GRID COORDINATES	APPROXIMATE HECTARES (ACRES)	APPROXIMATE MAXIMUM DEPTH METERS (FEET)	REMARKS
1	Marshy area-North Fork	465615	4 (10)		Formed above beaver dams.

TABLE B-9
FORDS*

MAP NUMBER	GRID COORDINATES	APPROXIMATE DEPTH METERS (FEET)	APPROXIMATE LENGTH METERS (FEET)	APPROXIMATE WIDTH METERS (FEET)	BOTTOM COMPOSITION	APPROACHES COMPOSITION AND CONDITION	REMARKS
1	441579	0.3 (1)	15.8 (52)	3 (11)	Gravel and silt	Clay. Easy (sometimes muddy)	Nos. 1 and 2: Vehicular fords. High water, Dec thru Feb. Fording conditions generally poor. Low water, May to Nov. Fording conditions generally good.
2	450589	0.3 (1)	8.2 (27)	3 (11)	Gravel and silt	Clay. Easy	

* Fords plotted on the map are commonly used sites. There are many other places not plotted on the map that may be used as fords during low water. Widths and depths calculated at average low water. Stream velocities not available.

YAKIMA FIRING CENTER

Very little of the surface drainage of the Yakima Firing Center is perennial. Only a short section of Squaw Creek, flowing westward into the Yakima River and about five miles of Cold Creek, flowing eastward and then southerly into the same river, are perennial. The numerous other valleys and canyons on the reservation contain intermittent streams that are dry most of the year. The principal ones include Selah Creek which drains westward to the Yakima River and Sourdough, Alkali and Corral Canyons and Hanson Creek that drain eastward into the Columbia River. There is also an irrigation canal which flows around part of the cantonment area. This canal receives water from the Roza Canal and Yakima River. An abandoned irrigation ditch carries water intermittently along the north side of part of the Selah Creek valley. Year-round precipitation is generally so light that most runoff is absorbed by the soil leaving only a very minimal flow into the streams. Numbered features in the tables below can be located on the Surface Configuration/Surface Drainage map.

All the valleys and canyons have intermittent spring-fed seeps flowing for short distances. The areas near these springs are often marshy in the summer and this condition may continue downstream for up to 0.8 kilometers (0.5 miles). In winter, these wet areas may contain standing water to a flowing trickle. There are also a few large springs which flow on the surface for short distances before sinking into the ground.

Under certain weather conditions nearly all the streams flow heavily. Occasional cloudbursts may occur in late spring-early summer and in the autumn causing flash floods. On an average of about once every four or five years, warm winds (chinooks) flow over the snow covered mountains of the reservation in or about the month of February causing a rapid snow melt. Because the surface is frozen and largely impermeable, heavy runoff occurs causing very strong stream flows and flooded conditions for short periods. This condition causes easily the most serious drainage problem on the reservation.

YAKIMA FIRING CENTER

TABLE B-10
DRAINAGE CHARACTERISTICS

DRAINAGE CATEGORIES	GENERAL	REGIME	WIDTHS	DEPTHS	VELOCITY AND DISCHARGE	BANKS	BOTTOMS
Perennial Watercourses							
Squaw Creek	Small stream flows rapidly through narrow valley in westerly direction. Stream perennial for about last two miles before leaving reservation and intermittent for about five miles above perennial section. Spring fed.	High water about March and April. Low water about August.	About 0.8 m (2.5 ft) at low water. As much as 9.1 m (30 ft) in flash floods	About 0.15 m(0.5 ft) or less at low water. As much as 1.5 m (5 ft) in flash floods.	Velocity moderate to fairly rapid at low water. Average discharge about 0.03 m^3/sec (1 ft^3/sec). Torrential flows may occur following thunderstorms in late spring and autumn and in some winters when chinooks blow.	Mostly silt loam with some sand. Average height of about 0.6 m (2 ft) and gentle to moderate gradient.	Mostly cobble with some smooth caliche surfaces. Gradient 1-2%.
Cold Creek	Small incised stream flows rapidly through moderately sloped valley in easterly direction. Stream perennial for about last five miles before leaving reservation and intermittent for about two miles above perennial section. Spring fed.	High water about March and April. Low water about August.	About 0.8 m (2.5 ft) at low water and much wider in flash floods.	About 0.15 m(0.5 ft) or less at low water. Very deep in floods.	Velocity moderate to fairly rapid at low water. Average discharge about 0.03 m^3/sec (1 ft^3/sec). Torrential flows may occur following thunderstorms in late spring and autumn and in some winters when chinooks blow.	Mostly silt loam with gravel layers. Height may exceed 6.1 m(20 ft) and steep.	Mostly gravel with some clay. Gradient averages about 3%.
Reservoirs							
1 Taylors Pond	Approximately 0.4 ha (1 acre). Developed spring. Earth fill semi-circle dam has rock and clay spillway. Empties into Selah Creek.	Perennial spring maintains full pool year around.	About 69 m(225 ft) long by 30 m (100 ft) wide.	About 4.6 m (15 ft).	Average discharge about 0.0013 m^3/sec (0.045 ft^3/sec).	Mostly silt and clay and low.	Mostly silt.
2 Kiddies Pond	Approximately 0.2 ha (0.5 acres). Fed by irrigation water from Roza Canal. Dammed by earth road fill. Overflow through road culvert.	Pool maintained by irrigation water spring and summer. Allowed to dry in winter.	About 59 m(195 ft) long by 30 m(98 ft) wide.	About 4.6 m(15 ft) at one point.	No appreciable discharge.	Mostly silt and clay and low.	Mostly silt.

TABLE B-11
FORDS*

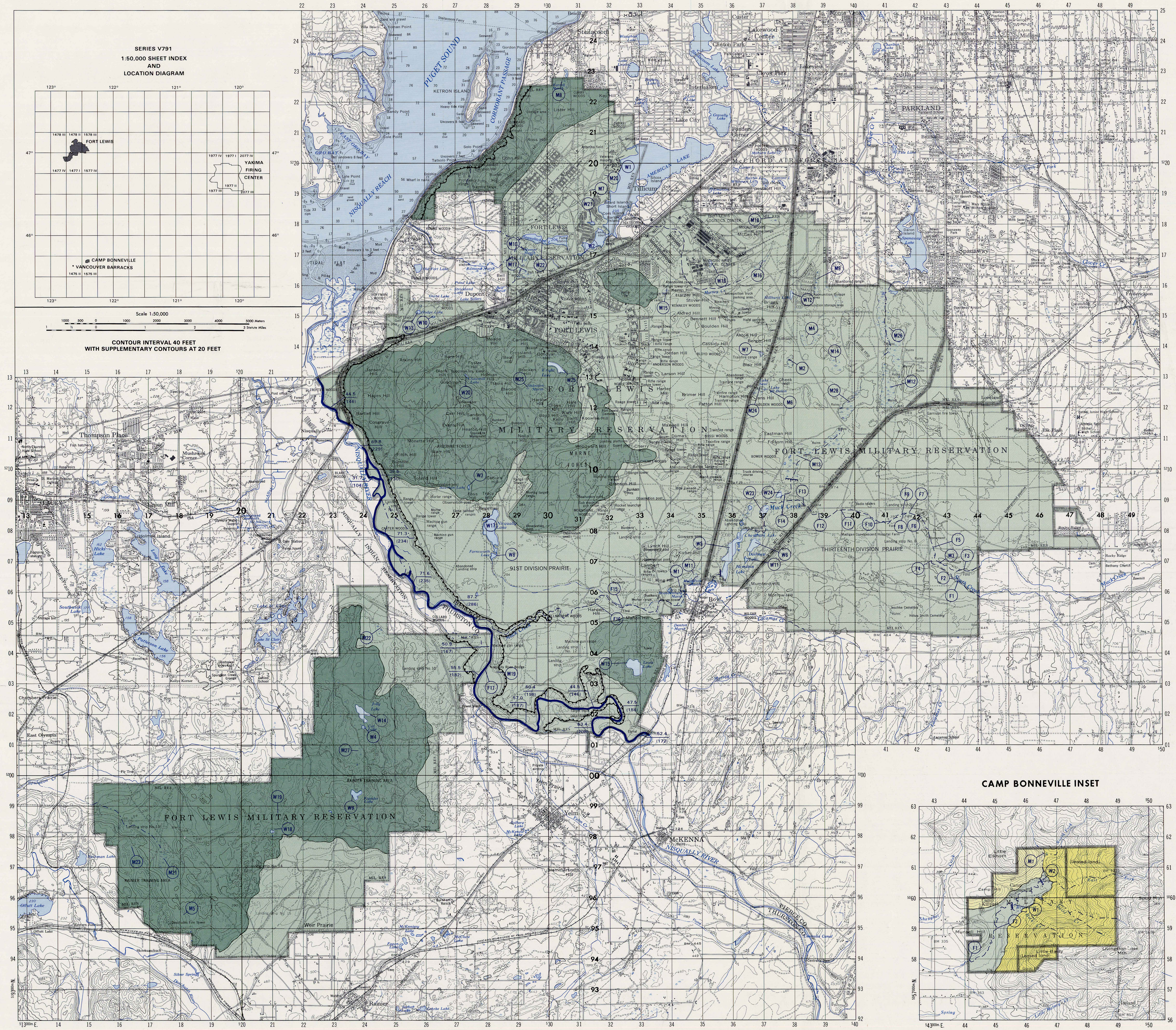
MAP NUMBER	GRID COORDINATES	APPROXIMATE DEPTH METERS (FEET)	APPROXIMATE LENGTH METERS (FEET)	APPROXIMATE WIDTH METERS (FEET)	BOTTOM COMPOSITION	APPROACHES COMPOSITION AND CONDITION	APPROXIMATE STREAM VELOCITY M/SEC (FT/SEC)	REMARKS
1	039858	0.15 (0.5)	0.8 (2.5)	3 (10)	Cobble and gravel	Silt loam and sand. Easy.	Seldom a limiting factor. See note.	Vehicular ford. No seasonal limitations.
2	712659	0.15 (0.5)	0.8 (2.5)	3 (10)	Gravel	Silt loam and gravel. Easy.	Seldom a limiting factor. See note.	Vehicular ford. No seasonal limitations.
3	749644	0.15 (0.5)	0.8 (2.5)	3 (10)	Gravel	Silt loam and gravel. Easy.	Seldom a limiting factor. See note.	Vehicular ford. No seasonal limitations.

* Fords plotted on the map cross perennial streams. Most stream beds on the base are generally dry and can be crossed wherever the banks are not too high. Poor fording conditions exist only following occasional late spring-autumn cloud-bursts and after chinooks (warm winds) have rapidly melted winter snow cover; streamflows may then become extremely heavy for short periods. Stream widths and depths are calculated at average low water.

FORT LEWIS, WASHINGTON

(Including Camp Bonneville, Vancouver Barracks and Yakima Firing Center)

TERRAIN ANALYSIS



SURFACE CONFIGURATION
FORT LEWIS

1	Low Plains	Flat to gently rolling plains; local relief generally from 25-45 m; slopes largely between 0 and 8%.
2	High Plains	Moderately rolling plains; local relief generally from 50-60 m; slopes mainly between 0 and 15%.
	Escarpments	Steep escarpments; local relief generally 12-60 m; slopes usually exceed 30%.

SURFACE DRAINAGE
FORT LEWIS

Watercourse width

- >25 m (>82 ft)
- 15-25 m (49-82 ft)
- 10-15 m (33-49 ft)
- 3-10 m (10-33 ft)
- 0-3 m (0-10 ft)

43.6 / (141.6) Bank to bank gap width m / (ft)

M28 Wet area (swamp or marsh)

W24 Lake (or reservoir)

F17 Ford

Dam

Number refers to entry in table.

SURFACE CONFIGURATION
CAMP BONNEVILLE

1	Low Plains	Flat to gently rolling plains; local relief generally from 25-45 m; slopes largely between 0 and 8%.
2	Low Hills	Predominantly rounded hills; local relief generally from 190-230 m; slopes largely between 8 and 30%.
3	High Hills	Rounded hills; local relief generally from 300-350 m; slopes mainly between 15 and 30%.

SURFACE DRAINAGE
CAMP BONNEVILLE

Watercourse width

- 3-10 m (10-33 ft)
- 0-3 m (0-10 ft)

M1 Wet area (swamp or marsh)

W2 Lake (or reservoir)

F2 Ford

Dam

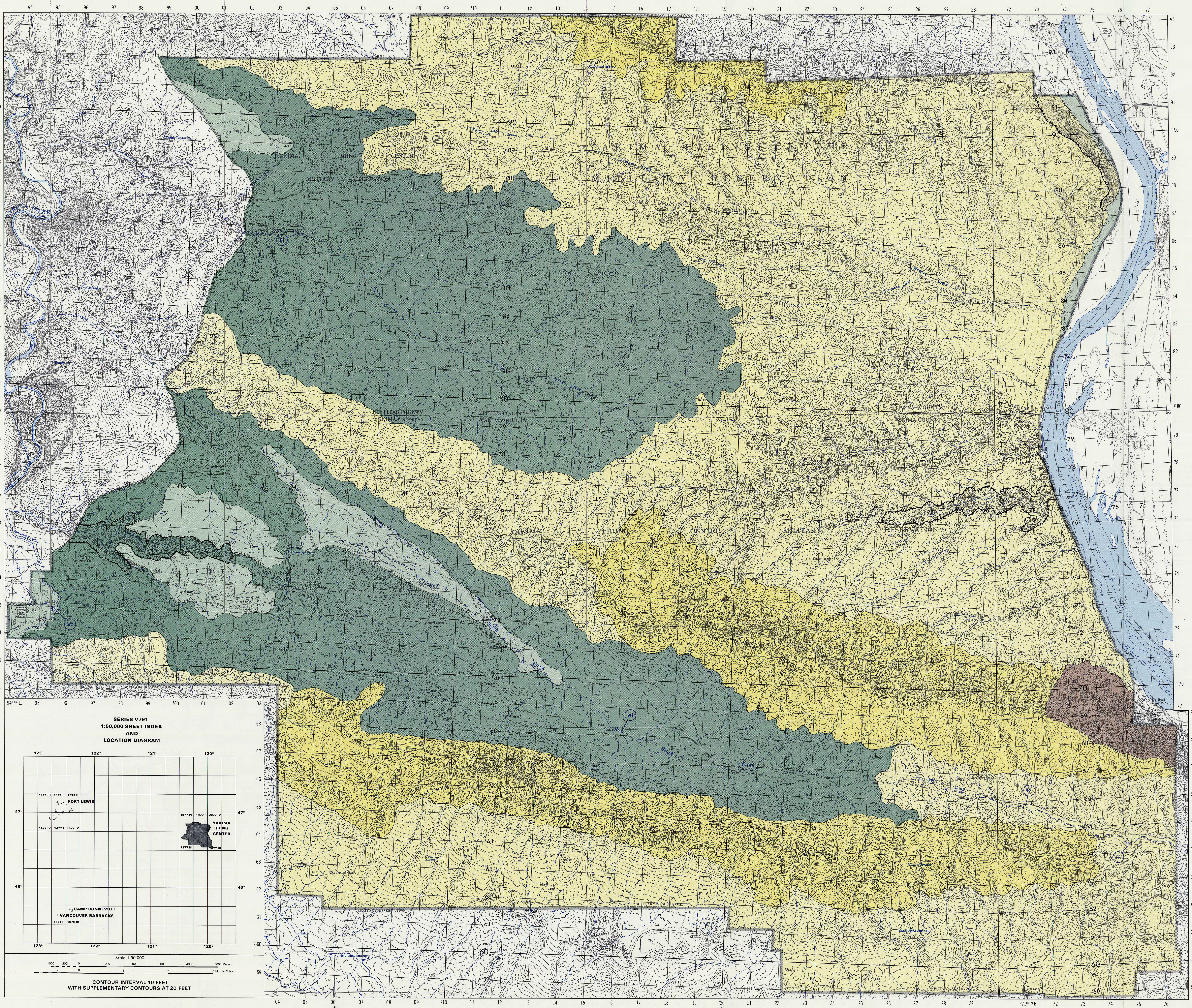
Number refers to entry in table.

Prepared by the Terrain Analysis Center, U. S. Army Engineer Topographic Laboratories, Fort Belvoir, Virginia, March 1977. Cartographic and Reproduction Support by the Defense Mapping Agency Hydrographic/Topographic Center, Washington, D. C. December 1978.

FORT LEWIS, WASHINGTON

(Including Camp Bonneville, Vancouver Barracks and Yakima Firing Center)

TERRAIN ANALYSIS



SURFACE CONFIGURATION

YAKIMA FIRING CENTER

1	Low Plains	Flat to gently rolling surfaces; local relief generally from 25-35 m; slopes mainly between 0 and 8%.
2	High Plains	Moderately rolling plains; local relief generally from 55-145 m; slopes mainly between 3 and 15%.
3	Low Hills	Predominantly rounded hills; local relief generally from 155-275 m; slopes largely between 8 and 30%.
4	High Hills	Rounded hills; local relief generally from 300-410 m; slopes mainly between 15 and 45%.
5	Mountains	Rounded mountains; local relief generally from 660-715 m; slopes largely between 45 and 60%.
	Escarpments	Steep escarpments; local relief generally 60-120 m; slopes usually from 45 to over 60%.

SURFACE DRAINAGE

YAKIMA FIRING CENTER

Watercourse width

0-3 m (0-10 ft)

W2 Reservoir

F3 Ford

Dam

Number refers to entry in table.

Prepared by the Terrain Analysis Center, U. S. Army Engineer Topographic Laboratories, Fort Belvoir, Virginia, March 1977. Cartographic and Reproduction Support by the Defense Mapping Agency Hydrographic/Topographic Center, Washington, D. C. December 1978.

C. WATER RESOURCES

1. SURFACE WATER

FORT LEWIS

Data on water quantity and quality at Fort Lewis are limited. There are no standard gaging or water quality stations on post. The only official records applicable to Fort Lewis are published by the US Geological Survey. These relate to the Nisqually River Station located upstream from the installation. In addition to this limited official data, some estimates of discharge and water quality for several smaller streams on post were obtained from the office of the Post Engineer. Estimates of surface water resources are summarized on the accompanying Water Resources Map. Ephemeral streams are not delineated, as they carry water at such infrequent intervals that they are not reliable sources of water.

Much of Fort Lewis consists of coarse granular glacial outwash, and precipitation tends to infiltrate into the soil rather than running off on the surface. Few streams cross the area. The only major perennial stream is the Nisqually River. Portions of Muck Creek and the other streams usually dry up in the summer. There are many lakes, whose levels are controlled primarily by ground water. Available information indicates that several of these lakes go dry in dry years. About one-third of American Lake (total area of 470 hectares, or (1,162 acres) is located within the military reservation. It is separated from Sequalitchew Lake, located completely within Fort Lewis, by a gravel barrier about 274 meters (300 yards) wide. The surface of American Lake is 9 meters (29 feet) higher than Sequalitchew. It has been postulated that the pores in the bed of American Lake, at least that portion near Sequalitchew Lake, have been so thoroughly filled with silt that there is no underground connection between them. A diversion from Muck Creek is sometimes used to supply additional water to Nisqually Lake. Many of the lakes are stocked for fishing, so sufficient quantities of water must be maintained to preserve aquatic life.

Muck Creek above Chambers Lake, Lacamas Creek, and Murray Creek have been designated Class AA (Extraordinary) water quality by the State of Washington; the Nisqually River, Muck Creek below Chambers Lake, and the remaining streams on Fort Lewis have been designated Class A (Excellent). Lakes and ponds on the installation are classified Lake Class. This means that all these are generally suitable as sources of water supply for domestic, industrial, and agricultural uses. Occasionally, the coliform bacteria standard for bathing beaches is exceeded in some of the lakes on the post.

Data on the most important streams and lakes on Fort Lewis are summarized in Table C-1 below. Caution should be exercised in use of these data. Much of it represents estimates based on limited information and there are wide seasonal variations. Discharge is generally given in a range of flows which hopefully includes the maximum and minimum for all but the dry portion of the year.

Table C-2 presents additional data on water quality for the Nisqually River near La Grande, about 32 kilometers (20 miles) upstream from the reservation. The chemical analyses and water temperatures at La Grande are probably typical of conditions in the Nisqually River on Fort Lewis. Similar data are not available for any other streams which cross the post.

TABLE C-1, SURFACE WATER RESOURCES

STREAM OR LAKE	LENGTH OR AREA ON FT. LEWIS	QUANTITY[1]	QUALITY[2]	DEVELOPMENT[3]
Nisqually River	25 km (15.5 mi)	Enormous * quantities of water available at all times from this perennial stream. Minimum daily discharge is 300,000 liters/minute (114,000,000 gpd**). Average discharge over 29-year period is 3,140,000 liters/minute (1,200,000,000 gpd).	Silt laden, except period from mid-May to mid-August. Water temperature ranges from 2° to 15° C (36° to 57° F). (See chemical analyses and water temperatures in Table C-2)	Only stream crossing Fort Lewis which has much reliable data available. Most measurements have been made at La Grande, about 32 km (20 mi) upstream. Flow has been regulated for over 30 years. River bottom sometimes floods in winter. Shifting channels. Migration route for spawning salmon and trout. Nisqually River forms southwestern boundary of Fort Lewis proper and one mile of the river separates the Rainier Training Area from the main post.
Muck Creek	21 km (13 mi)	Very large quantities of water available most of year. Seasonal stream, portions dry up in summer. Estimated discharge 10,000 to 30,000 liters/minute (4,000,000 to 12,000,000 gpd) for most of the year.	Remains clear even when flooding. Has a brown stain in winter.	Except for Nisqually River, this is most important stream on the post. Fish spawning stream.
South Creek	1.6 km (1 mi)	Large quantities of water available in winter and spring. Dries up in summer. Estimated seasonal discharge is 1,000 to 3,000 liters/minute (400,000 to 1,200,000 gpd) except in late summer or fall when it dries up.		
Lacamas Creek	1.2 km (0.75 mi)	Very large quantities of water available most of year. Seasonal stream. Discharge generally between 5,000 to 25,000 liters/minute (1,500,000 to 10,000,000 gpd) during most of the year.	Relatively clear. Some brown stain during high water.	Crosses only a corner of Fort Lewis.
Murray Creek	4.8 km (3 mi)	Very large quantities of water available most of year. Seasonal. Discharge generally between 10,000 to 30,000 liter/minute (3,000,000 to 12,000,000 gpd) except during the summer.	Clear spring water. Fairly constant cool temperature.	Upper 0.8 km (2 mi) are an excavated channel with a mucky bottom. Fishing area.
Clear Creek	1.8 km (1.1 mi)	Very large quantities of water available all year, with a very stable flow. Discharge averages between 15,000 to 40,000 liters/minute (4,000,000 to 15,000,000 gpd).	Very clear spring water with a relatively constant temperature of about 10°C (50° F).	Stream from important springs to Nisqually River.
Sequalitchew Creek	1.2 km (0.75 mi)	Large quantities of water available for about half of year.	Generally clear.	Drains Sequalitchew Lake through a swampy area.
Halverson Channel	0.8 km (0.5 mi)	Very large quantities of water available. Discharge generally 5,000 to 25,000 liters/minute (1,500,000 to 10,000,000 gpd) for most of the year.	Clear water.	Drains Halverson Marsh into Muck Creek.
(Unnamed stream; centered on grid reference 302053)	200 m (600 ft)	Very large quantities of water available in winter and spring. Average discharge generally between 10,000 to 40,000 liters/minute (3,000,000 to 15,000,000 gpd). Dries up in summer.	Very clear. Temperature about 10° C (50° F).	Short stream from Exeter Springs to Muck Creek. Spawning area for chum salmon.
(Unnamed stream; centered on grid reference 248091)	300 m (1,000 ft)	Very large quantities of water available most of year.		Short stream from Hill Springs to Nisqually River.
American Lake	151 hectares (374 acres)	Enormous quantities of water available all year. Maximum depth is 27 meters (50% is more than 15 meters). Estimated yield greatly exceeds 40,000 liters/minute (15,000,000 gpd).	Hardness: 51 mg/liter calcium carbonate. pH = 6.8 to 8.3. Secchi disc reading 4.1 to 7.7 m (13.6 to 25.4 ft). Probably some sewage contamination from septic tanks.	One-third of lake is within reservation. Total area is 470 hectares (1,123 acres). Fish stocking program.
Chambers Lake	40 hectares (100 acres)	Large quantities of water available all year. Estimated yield between 400 to 1200 liters/minute (150,000 to 450,000 gpd).	Hardness: 51 mg/liter calcium carbonate. pH = 6.5 to 7.0. Secchi disc reading 0.8 m (2.9 ft).	This is a reservoir on Muck Creek. Dam has concrete spillway. Good trout fishing.
Nisqually Lake	40 hectares (100 acres)	Large quantities of water available all year. Estimated yield 400 to 1200 liters/minute (150,000 to 450,000 gpd).		A ditch from Muck Creek diverts additional water into lake. Fish stocking program. Popular fishing area, although its use is sometimes restricted because it is located in artillery impact range.
Sequalitchew Lake	32 hectares (80 acres)	Large quantities of water available all year. Estimated yield 400 to 1600 liters/minute (150,000 to 600,000 gpd).		Fish stocking program. Used by troops as a bridging site.
Lewis Lake	22 hectares (54 acres)	Moderate quantities of water available all year. Estimated yield 160 to 400 liters/minute (60,000 to 150,000 gpd).	Hardness: 17 mg/liter calcium carbonate. pH = 6.5 to 7.0. Secchi disc reading 1.9 m (6.3 ft).	Lake is created by a road fill.
Dailman Lake	12 hectares (30 acres)	Moderate quantities of water available all year. Estimated yield 40 to 275 liters/minute (15,000 to 100,000 gpd).	Hardness: 51 mg/liter calcium carbonate. pH = 6.5 to 7.0. Secchi disc reading 0.8 m (2.9 ft).	Flooded from backup of Chambers Lake; it was originally very shallow. Lake goes dry in dry years.
Fiander Lake	12 hectares (30 acres)	Moderate quantities of water available all year. Estimated yield between 40 to 275 liters/minute (15,000 to 100,000 gpd).		Partially covered with hardhack.
Jolly Lake	11 hectares (27 acres)	Moderate quantities of water available all year. Estimated yield between 40 to 275 liters/minute (15,000 to 100,000 gpd).	Hardness: 17 mg/liter calcium carbonate. pH = 6.0 to 6.5. Secchi disc reading .6 to .7 m (2.0 to 2.5 ft). Darkly stained.	The existing dam is not a water-tight structure and some leakage occurs.
Hamilton Lake	6.5 hectares (16 acres)	Moderate quantities of water available all year. Estimated yield between 40 to 110 liters/minute (15,000 to 40,000 gpd).	Hardness: 51 mg/liter calcium carbonate. pH = 6.5 to 7.0. Secchi disc reading 0.8 m (2.9 ft).	One of several lakes northeast of the town of Roy.
Wright Lake	4.5 hectares (11 acres)	Moderate quantities of water available all year. Estimated yield 40 to 80 liters/minute (15,000 to 30,000 gpd).	Secchi disc reading 2.1 m (6.9 ft).	Located in a marshy area.
Farnsworth Lake	2.8 hectares (7 acres)	Small quantities of water available all year. Estimated yield between 12 to 40 liters/minute (5,000 to 15,000 gpd).		A small lake near the south end of Nisqually Lake.
Shaver Lake	2.4 hectares (6 acres)	Small quantities of water available all year. Estimated yield between 16 to 40 liters/minute (6,000 to 15,000 gpd).		Overgrown with reed canary-grass.
Hillhurst Lake	1.6 hectares (4 acres)	Small quantities of water available all year. Estimated yield between 12 to 40 liters/minute (5,000 to 15,000 gpd).		Partially covered with willow and hardhack.
Hodge Lake	1.6 hectares (4 acres)	Small quantities of water available all year. Estimated yield between 12 to 40 liters/minute (5,000 to 15,000 gpd).		Goes dry in extremely dry years.
Sears Lake	1.6 hectares (4 acres)	Small quantities of water available all year. Estimated yield between 12 to 40 liters/minute (5,000 to 15,000 gpd).		Maximum depth 3.2 m (10.5 feet).
Cat Lake	1.2 hectare (3 acres)	Small quantities of water available all year. Estimated yield between 12 to 40 liters/minute (5,000 to 15,000 gpd).	Hardness: 17 mg/liter calcium carbonate. pH = 6.0 to 6.5. Secchi disc reading 2.2 m (7.3 ft).	Maximum depth 7 m (23 feet).
No Name Lake	1.2 hectare (3 acres)	Small quantities of water available all year. Estimated yield between 4 to 30 liters/minute (1,500 to 10,000 gpd).	Hardness: 34 mg/liter calcium carbonate. pH = 6.5 to 7.0. Secchi disc reading 1.6 to 2.4 m (5.3 to 8.0 ft).	Located in the southwestern Rainier Training Area.
Sawmill Lake	1.2 hectare (3 acres)	Small quantities of water available all year. Estimated yield between 4 to 30 liters/minute (1,500 to 10,000 gpd).		Located in the rolling topography southwest of the cantonment area.
Lynn Lake	1 hectare (2.5 acres)	Small quantities of water available all year. Estimated yield between 4 to 25 liters/minute (1,500 to 9,000 gpd).		Plans to excavate lake and stock with trout.
American Lake Pond	1 hectare (2.5 acres)	Small quantities of water available all year. Estimated yield between 4 to 25 liters/minute (1,500 to 9,000 gpd).	Hardness: 51 mg/liter calcium carbonate. pH = 6.5 to 7.0. Secchi disc reading 2.1 m (7 ft).	In reality, part of American Lake, connected by a narrow channel.
Bauman Lake	0.8 hectare (2 acres)	Small quantities of water available all year. Estimated yield between 4 to 20 liters/minute (1,500 to 8,000 gpd).		Maximum depth 2.4 m (8 ft) in wet years; goes dry occasionally.
Elias Lake	0.8 hectare (2 acres)	Small quantities of water available all year. Estimated yield between 4 to 20 liters/minute (1,500 to 8,000 gpd).		Partially covered with hardhack. Goes dry in dry years.

C. WATER RESOURCES (continued)

1. SURFACE WATER

FORT LEWIS

TABLE C-1, SURFACE WATER RESOURCES (continued)

STREAM OR LAKE	LENGTH OR AREA ON FORT LEWIS	QUANTITY[1]	QUALITY[2]	DEVELOPMENT[3]
Golf Course Lake	0.6 hectare (1.5 acres)	Small quantities of water available all year. Estimated yield between 4 to 20 liters/minute (1,500 to 8,000 gpd).		Was deepened and enlarged during expansion of the golf course.
Rebeckah Lake	0.4 hectare (1 acre)	Small quantities of water available all year. Estimated yield between 4 to 16 liters/minute (1,500 to 6,000 gpd).		Very small lake in the southwestern Rainier Training Area.
		There are some additional small lakes and ponds on Fort Lewis that could provide water for short periods of time.		

*Definitions of underlined terms are as follows:

	Liters Per Minute (lpm)	Gallons Per Day (gpd)
Enormous	>40,000	>15,000,000
Very Large	4,000–40,000	1,500,000–15,000,000
Large	400–4,000	150,000–1,500,000
Moderate	40–400	15,000–150,000
Small	4–40	1,500–15,000

**Gallons per day

USER NOTE: For permissible concentrations of impurities in military water supplies, see Department of the Army Technical Manual TM 5-700, *Field Water Supply*, July 1967, paragraph 19, or other applicable manuals or regulations.

[1]Yields of lakes have been calculated based on the estimated volume and the flow to empty the lake in a year without recharge.

[2]All the streams and lakes on Fort Lewis have water with Class A quality or better, according to State of Washington standards. Class A water meets the requirements for sources of water supply for domestic, industrial, and agricultural uses. For practical purposes of this study, milligrams/liter and parts per million (ppm) are equivalent.

[3]Some lakes are partially covered with hardhack or other vegetation. These lakes are less desirable as sources of water supply. Known marshes have not been included in this list. Information indicates that some lakes dry up in dry years, but evidently they usually contain water throughout the year.

TABLE C-2, WATER QUALITY, NISQUALLY RIVER

CHEMICAL ANALYSES

Location: 46°50'37"N, 122°19'46"W. 1.1 kilometers (0.7 miles) northwest of La Grande, 32.2 kilometers (20.0 miles) upstream from reservation boundary at Burlington Northern Railroad Bridge.
Time: Water year October 1972 to September 1973.

Factor	Range of Values from 24 Semi-monthly Samples
Instantaneous Discharge	416 to 2350 ft³/sec
Total Nitrate (N)	0.02 to 0.20 mg/liter
Total Nitrite (N)	0.00 to 0.02 mg/liter
Ammonia Nitrogen (N)	0.00 to 0.31 mg/liter
Organic Nitrogen (N)	0.01 to 0.79 mg/liter
Total Kjeldahl Nitrogen (N)	0.05 to 1.1 mg/liter
Total Phosphorus (P)	0.00 to 0.9 mg/liter
Dissolved Ortho Phosphorus (P)	0.00 to 0.1 mg/liter
Specific Conductance	44 to 71 micromhos
pH	6.9 to 7.6 units
Temperature	3.9 to 13.6 degrees, C
Color	2 to 64 platinum-cobalt units
Turbidity	2 to 40 JTU
Dissolved Oxygen	10.2 to 13.2 mg/liter
Immediate Coliform	20 to 620 col/100 ml

WATER TEMPERATURES

Location: 46°50'25"N, 119°19'38"W. 1.0 kilometer (0.6 miles) northwest of La Grande, 33.2 kilometers (20.6 miles) upstream from reservation boundary at Burlington Northern Railroad Bridge.
Time: Water year October 1973 to September 1974.

Month	Monthly Range of Temperatures (measured daily) Degrees Centigrade (Fahrenheit)
October 1973	11.0 to 14.0 (51.8 to 57.2)
November 1973	6.5 to 11.0 (43.7 to 51.8)
December 1973	6.0 to 7.0 (42.8 to 44.6)
January 1974	4.0 to 7.5 (39.2 to 63.5)
February 1974	4.5 to 5.0 (40.1 to 41.0)
March 1974	4.5 to 5.0 (40.1 to 41.0)
April 1974	5.0 to 7.0 (41.0 to 44.6)
May 1974	7.0 to 8.5 (44.6 to 47.3)
June 1974	8.5 to 9.0 (47.3 to 48.2)
July 1974	9.0 to 11.0 (48.2 to 51.8)
August 1974	11.0 to 12.5 (51.8 to 54.5)
September 1974	11.5 to 13.5 (52.7 to 56.3)

Note: For period of record 1965 to 1975, minimum temperature was 2°C (35.6°F) and maximum temperature was 14.5°C (58.1°F).

2. GROUND WATER

FORT LEWIS

Information on the ground water of Ft. Lewis is available from the wells and springs on the post, from areal studies which includes the post, and from studies of neighboring areas where conclusions from similar hydrogeologic conditions are assumed to indicate similar ground water conditions at Ft. Lewis. Water levels vary in response to precipitation. In general, they are highest during the period November through March, and lowest June through August. However, in the coarse-grained outwash deposits, seasonal variations are minimal.

The ground water in the Ft. Lewis area is generally of excellent quality. Water supplies in the range of 50 to 100 milligrams per liter including dissolved solids are available. Ground water is being tapped increasingly for irrigation, industrial use, and other purposes but annual replenishment is well in excess of present draft.

On the gravel plains recharge from average precipitation has been estimated at 1.46 million liters per day per square kilometer (1 million gallons per day per square mile). At present rates of withdrawal, danger of salt water intrusion from Puget Sound is remote, except if new wells of large capacity are sited near the beach.

TABLE C-3, GROUND WATER RESOURCES

MAP UNIT	QUANTITY AND SOURCE	DEPTH	QUALITY	DEVELOPMENT OF SOURCES
1	Moderate to very large quantities from coarse sand and gravel aquifers derived from glacial outwash. Materials are poorly sorted to moderately well sorted and bedding is irregular and commonly lenticular, pinching out within short distances. Lenses of silt and fine sand are minor elements in these deposits. Outwash comprises the most productive aquifers in the study area; yields of up to 34,067 lpm (9,000 gpm) have been reported from these deposits outside of the study area. Outwash may occur as two major associations of predominantly coarse sand and gravel separated by unproductive clayey glacial till. Each outwash association is comprised of alternating layers of coarse sand and gravel; the coarsest materials predominate in the uppermost association. Sequalitchew Springs, west of the southern point of American Lake, is one of the most important sources of water supply for Fort Lewis, its yield averaging about 13,154 lpm (3,475 gpm). Other springs are present but are not common. The largest ones are indicated on the accompanying map but data on discharges are not available. Below the outwash deposits, additional sand and gravel layers in geologically older materials yield good water but not as abundantly as does the outwash. These deposits are more than 457 m (1,500 ft) thick near American Lake and pinch out toward the south. Wells extended into these deposits increase their yield. Most of these aquifers are under artesian pressure and some of these wells might flow at the surface. Transmissibility of the outwash has been measured in areas adjoining Fort Lewis and are representative of the values to be expected within the study area. They range from 58,000 to more than 2,000,000 gallons per day per foot. All the values are high, the variability being attributed to the irregular sorting and stratification of the deposits.	The upper association of outwash is of variable thickness depending on geographic location ranging from 0 to 61 m (0 to 200 ft). The lower association of outwash may range up to 30 m (100 ft) in thickness. The outwash thins to the south in Fort Lewis. The thickness depends on the configuration of the surface on which the outwash was deposited and cannot be predicted. It may be determined by exploratory drilling. Where till is exposed at the surface, only the lower association of outwash will be present. Water levels in the outwash, where the wells are below the water table, show only minor seasonal variations.	Ground water from the outwash is generally of good quality and may be used for all purposes. The waters are generally high in dissolved silica but are low in hardness and low in total dissolved solids. In places, the iron content is excessive. In general, variations from optimum quality are not considered significant. Analyses of water samples from selected wells at Fort Lewis are presented in Table C-4. The coarse sands and gravels in these areas are very porous and highly permeable. Solid waste deposits should not be sited in these areas because the leachate from the waste can migrate readily downward to the aquifer and contaminate the ground water.	Access is easy to potential well sites on the sand and gravel plains. Wells are easily drilled and should be cased to prevent collapse of the unconsolidated materials into the well. Wells should be screened and developed to reduce the inflow of sand to a minimum. Depths and diameters of existing wells are reported in Table C-4. Proposed sites at higher elevations may be unproductive if the base of the outwash deposits lies above the zone of ground water saturation as indicated by the water level contours on the accompanying map. Wells that terminate above the water table can only produce if they tap perched water supplies. Perched supplies are generally subject to significant seasonal variations and may go dry.

C. WATER RESOURCES (continued)
2. GROUND WATER
FORT LEWIS

TABLE C-3, GROUND WATER RESOURCES (continued)

MAP UNIT	QUANTITY AND SOURCE	DEPTH	QUALITY	DEVELOPMENT OF SOURCES
2	Generally small quantities from alluvium on Nisqually River flood plain. Interbedded silty clay and fine sand intermixed with lesser amounts of coarse sand, gravel and shells. Irregularly bedded and lenticular, in places well stratified. Individual beds range from less than a foot thick and of small areal extent to several feet in thickness. Wells in coarse sand and gravel may yield large quantities of water where thick deposits of alluvium are present. The river alluvium grades down into older deposits which are also unconsolidated and it may not be possible to distinguish between the two types of deposits in wells. Transmissibility has been measured only for a well in the Puyallup River valley alluvium. The value of 1,000 gpd per foot obtained is assumed to be representative of fine-grained aquifers. A larger value would be expected from the coarse sand and gravel aquifers.	No data are available on the depth of the Nisqually River alluvium within the boundary of Fort Lewis. Outside the boundary, near the town of Nisqually, two wells tap an aquifer at a depth of 30 m (100 ft). The alluvium is thought to extend to depths of 46 to 61 m (150 to 200 ft) but the deeper layers may be glacial outwash deposits. Upstream, and where the flood plain is narrower, the alluvium may not be as deep.	No analyses are available. However, a sample from a well near Nisqually, taken 16 Nov 1955, may be considered representative of the alluvium. Well is 37 m (120 ft) deep and is located at NE¼/NE¼, sec. 18, T. 18N, R. 1E. Analysis in mg/l. Silica 36.00 Iron .24 Calcium 12.00 Magnesium 5.70 Sodium 6.40 Potassium 2.10 Bicarbonate 75.00 Sulfate 2.90 Chloride 4.50 Fluoride 0.10 Nitrate 0.40 Dissolved solids 107.00 Calcium hardness 53.00 Specific conductance 139.00 pH 6.90 Color (Pt/Co scale) 5.00 The water is soft, somewhat high in silica, near the upper limit in iron content and a little low in fluoride. The water is of good quality and suited as a water supply.	Potential well sites in the valley are readily accessible but sites at lower elevations on the flood plain may be flooded during high water periods. Almost all wells should yield water. The water table is present at shallow depths and wells should have some artesian pressure but are not expected to flow at the surface. The wells near Nisqually tapped a sand and gravel aquifer. One tested 3,066 lpm (810 gpm) with a drawdown of 2.07 m (6.8 ft); the other had a flow of 946 lpm (250 gpm). Wells tapping thin layers of sand and gravel, or finer-grained materials, will have much smaller yields. Wells should be screened and developed to reduce sand inflow to a minimum. Wells extended deeply beneath the alluvium into the underlying unconsolidated deposits will develop still larger quantities of water as additional sand and gravel aquifers are penetrated.
3	Meager to moderate quantities from unknown assortment of glacial deposits, including some minor areas of alluvium and marsh or swamp deposits. Area as yet undifferentiated by field mapping, may include some small exposures of andesitic bedrock. Till is a heterogeneous mixture of fine and coarse-grained materials compacted to a hard concrete-like mixture. Outwash is characterized by the predominance of poorly-sorted to moderately well-sorted gravels interbedded with lenses of sand. Moderate quantities of water may be obtained from the gravel outwash; quantities may be large where thick sections of gravel are present. Till would yield insignificant quantities except where it includes coarse-grained materials. Other deposits would produce intermediate yields.	No detailed data are available on the deposits within this area. Thickness of the various deposits may be postulated based on known data from adjoining areas. Till is generally less than 15 m (50 ft) thick. Outwash, in general, thins to the south but topographic conditions may permit the accumulation of more than 30 m (100 ft) in places. Similarly, no data are available on the thickness of alluvium or marsh or swamp deposits but they are thought to be thin and of limited areal extent.	Specific data on the quality of water for this area are lacking. However, judging from areas where analagous conditions exist, the water in general is expected to be suitable for all uses. Locally, content of dissolved iron may be undesirably high.	In general, access to well sites would be easy on the plains, but somewhat hindered by the steeper slopes of some hills. Marsh or swamps are small and readily avoided. Wells could be drilled, dug or driven in the outwash. However, due to the low permeability of the till, dug wells of large diameter are required to increase the infiltration area into the well and provide storage space for the accumulated water. Dug wells of this type are subject to large seasonal fluctuations in the water level and some may go dry.
4	Meager yields would generally be obtained from volcanic rocks. Under favorable conditions improved yields, to small can be obtained. Generalized information indicates that the area is underlain by andesitic lava flows and breccia; possibly some basalt is also present. Identification and delineation of the areal extent of the volcanic types are not possible with the data at hand. Water is present in zones of vesicular lava, in open fractures, and in interbedded sediments between flows, if these elements are present. Surface weathering tends to reduce permeability and retard infiltration into fracture systems. Generalized information indicates that yields are insignificant. No wells of large yield have been reported from the volcanic rocks of Thurston County.	No wells are known to be sited in the volcanic rocks within the post. However, some dug wells in the volcanics have been reported from elsewhere in Thurston County. Such wells are generally less than 15 m (50 ft) in depth.	Water of poor quality has been reported from rocks of this geologic age in Thurston County. However, this category includes a large variety of rock types, both sedimentary and volcanic; it is not known whether the volcanic rocks were the source of this poor quality water. Moreover, it is not known what constituents caused the inferior quality and hence, whether it would be economical to improve the quality by treatment.	Access to potential sites would be difficult in the hilly and forested terrain underlain by these volcanic rocks. Large diameter or dug wells will supply small domestic requirements. Large diameter wells are necessary to maximize the area from which the small seepages can move into the well. Because of their small infiltration area, drilled wells are less productive than dug wells, even when drilled deeply. At depths exceeding 152 m (500 ft) openings in the rock may be closed by the weight of the overlying materials, thus reducing volumes where water may be stored.
5	Meager quantities of ground water are generally available from glacial till. Fresh till is a bluish-gray mixture of silt, clay, sand, gravel and boulders dumped in heterogeneous confusion by the glacier. It forms a hard, concrete-like deposit. In places, the till may include lenses or small deposits of sand, in places gravel, from which small quantities of water may be obtained.	Sources differ on the depths of wells in the till. Estimates range from 6 to 9 m (20 to 30 ft). Water levels are subject to seasonal fluctuations and are estimated to range between 2 to 6 m (7 to 20 ft).	Water is generally of good quality and suited for all uses. An analysis of a sample from a spring in Goddard Woods is reported in the accompanying table of chemical analyses. Generally, solid waste deposits may be sited over till without fear of contaminating deep ground water aquifers. However, the area should be tested to assure that lenticular sand layers are not present. Lateral migration of the leachate to surface water bodies should be avoided.	Access to potential well sites is generally hindered by hilly terrain; slopes are moderate but may be steep in places. Dug wells provide water for domestic use. Large diameter wells are required to permit maximum surface for infiltration of seeping waters into the well. Wells drilled through the till into unconsolidated sediments that may be as much as 610 m (2,000 ft) thick west of American Lake can tap deep aquifers of good quality water. These deeper aquifers are under artesian pressure and some wells may flow at the surface.

*Definitions of underlined terms are as follows:

	Liters Per Minute (lpm)	Gallons Per Day (gpd)
Very Large	4,000 - 40,000	1,500,000 - 15,000,000
Large	400 - 4,000	150,000 - 1,500,000
Moderate	40 - 400	15,000 - 150,000
Small	4 - 40	1,500 - 15,000
Meager	<4	<1,500

Note: For period of record 1965 to 1975, minimum temperature was 2°C (35.6°F) and maximum temperature was 14.5°C (58.1°F).

TABLE C-4, RECORDS OF SELECTED WELLS AND SEQUALITCHEW SPRINGS

MAP REFERENCE	ELEVATION ABOVE SEA LEVEL	WELL DEPTH	DIAMETER OF WELL	STATIC LEVEL	YIELD	SPECIFIC CAPACITY	DEPTH OF AQUIFER	AQUIFER MATERIAL	PUMPING TEST	DATE WELL STARTED	DATE WELL COMPLETED	REMARKS
1	71.3 m (234 ft)	68.2 m (224 ft)	45.7 cm (18 in)	38.1 m (125 ft)	2460 lpm (650 gpm)	12.6 lpm/m (10.95 gpm/ft)	58.5 to 65.2 m (192 to 214 ft)	Sand, gravel	No Data	No Data	11/1940	Inactive; reportedly sanded out.
2	71.3 m (234 ft)	72.8 m (239 ft)	45.7 cm (18 in)	39 m (128 ft)	4163 lpm (1100 gpm)	18.1 lpm/m (15.7 gpm/ft)	65.5 to 69.4 m (215 to 228 ft)	Sand, gravel	18.5 m at 3407 lpm (61 ft at 900 gpm) 20 m at 3785 lpm (65 ft at 1000 gpm) 21 m at 4164 lpm (70 ft at 1100 gpm)	12/1940	12/1941	Inactive; reportedly sanded out.
3	71.4 m (235 ft)	69.7 m (229 ft)	45.7 cm (18 in)	42.3 m (139 ft)	1892 lpm (500 gpm)	5.3 lpm/m (4.59 gpm/ft)	57.6 to 67 m (189 to 220 ft)	Sand, gravel	32 m at 1817 lpm (104 ft at 480 gpm) 33 m at 1893 lpm (109 ft at 500 gpm)	No Data	2/1941	
4	71.4 m (235 ft)	167.6 m (550 ft)	45.7 cm (18 in)	No Data	No Data	No Data	No Data	No Data	No Data	No Data	1942	Abandoned; filled in 10 April 1975.
5	71.4 m (235 ft)	No Data	61 cm (24 in)	63.3 m (208 ft)	No Data	No Data	No Data	No Data	No Data	No Data	No Data	Capped; located 61 m (200 ft) NE of Well #4.
6	85.9 m (282 ft)	301.7 m (990 ft)	96.5 to 50.8 cm (38 to 20 in)	43.8 m (144 ft)	1798 lpm (475 gpm)	No Data	64 to 79 m (210 to 260 ft) 91 to 108 m (300 to 355 ft) 186 to 190 m (610 to 626 ft) 201 to 211 m (660 to 692 ft) 223 to 226 m (732 to 740 ft) 273 to 276 m (895 to 905 ft) 291 to 293 m (955 to 962 ft)	Sand, gravel, clay	No Data	No Data	8/1942	Inactive; reportedly sanded out.
7	88.6 m (291 ft)	408.4 m (1,340 ft)	45.7 to 50.8 cm (18 to 20 in)	14.3 m (47 ft)	5299 lpm (1400 gpm)	14.8 lpm/m (12.83 gpm/ft)	32 to 40 m (105 to 130 ft) 62 to 66 m (204 to 216 ft) 104 to 106 m (340 to 348 ft) 244 to 251 m (800 to 825 ft) 290 to 302 m (950 to 990 ft) 378 to 387 m (1,240 to 1,270 ft)	Sand, gravel	34 m at 5489 lpm (113 ft at 1450 gpm)	No Data	11/1943	Gravel packed.

C. WATER RESOURCES (continued)

2. GROUND WATER

FORT LEWIS

TABLE C-4, RECORDS OF SELECTED WELLS AND SEQUALITCHEW SPRINGS (continued)

MAP REFERENCE	ELEVATION ABOVE SEA LEVEL	WELL DEPTH	DIAMETER OF WELL	STATIC LEVEL	YIELD	SPECIFIC CAPACITY	DEPTH OF AQUIFIER	AQUIFIER MATERIAL	PUMPING TEST	DATE WELL STARTED	DATE WELL COMPLETED	REMARKS
8	87 m (285 ft)	396 m (1,300 ft)	66 to 97 cm (26 to 38 in)	No Data	2650 lpm (700 gpm)	No Data	No Data	No Data	No Data	No Data	1941	Abandoned; filled in with gravel April 1975.
9	87.6 m (287 ft)	307 m (1,008 ft) (Also reported as being 2261 ft deep)	45.7 to 50.8 cm (18 to 20 in)	No Data	3028 lpm (800 gpm)	No Data	72 to 112 m (235 to 368 ft) 115 to 119 m (378 to 390 ft) 122 to 134 m (400 to 440 ft)	Sand, gravel	No Data	No Data	7/1944	
10	66 m (215 ft)	11 m (36 ft)	45.7 cm (18 in)	2.9 m (9.5 ft)	511 lpm (135 gpm)	No Data	5.4 to 11 m (18 to 36 ft)	Sand, gravel	No Data	No Data	11/3/1949	
11	102 m (336 ft)	36 m (118 ft)	No Data	14 m (45 ft)	94.6 lpm (25 gpm)	No Data	No Data	No Data	No Data	No Data	3/1959	Pump capacities 95 and 114 lpm (25 and 30 gpm).
12	102 m (336 ft)	15.8 m (52 ft)	15.2 cm (6 in)	No Data	83.2 lpm (22 gpm)	No Data	No Data	No Data	No Data	No Data	1951	Abandoned.
13	73 m (240 ft)	43 m (141 ft)	No Data	20 m (65 ft)	1352 lpm (350 gpm)	No Data	No Data	No Data	No Data	7/25/1960	No Data	Used for irrigation only.
14	67 m (220 ft) Estimated from topographic map	5.1 m (17 ft)	38.1 cm (15 in)	64.6 m (212 ft)	7570 lpm (2000 gpm)	768 lpm/m (666 gpm/ft)	No Data	No Data	1 m at 7570 lpm (3 ft at 2000 gpm)	No Data	1/1961	Located in Building 7980.
15	67 m (220 ft) Estimated from topographic map	4.8 m (16 ft)	122 cm (48 in)	3.6 m (12 ft)	4921 lpm (1300 gpm)	No Data	No Data	No Data	No Data	No Data	9/26/1962	15 m (50 ft) infiltration gallery with 6 m (20 ft) cross shaft. Located in Building 7980.
16	84 m (275 ft)	84 m (275 ft)	41 cm (16 in)	No Data	3406 lpm (900 gpm)	No Data	No Data	No Data	No Data	4/1964	1/1965	
17	94 m (310 ft)	136 m (445 ft)	41 cm (16 in)	25 m (82 ft)	3785 lpm (1000 gpm)	No Data	No Data	No Data	16.4 m at 1269 lpm (54 ft at 1100 gpm)	4/1964	1/1965	
18	73 m (240 ft)	67 m (220 ft)	35 cm (14 in)	23 m (76 ft)	2756 lpm (728 gpm)	105 lpm/m (91 gpm/ft)	No Data	No Data	2.4 m at 2756 lpm (8 ft at 728 gpm)	9/10/1968	No Data	Used for irrigation only.
19	87 m (285 ft)	No Data	41 to 25 cm (16 to 10 in)	34 m (110 ft)	4542 lpm (1200 gpm)	No Data	No Data	No Data	Pumped 33.75 hrs at 1832 to 2082 lpm (484 to 550 gpm)	7/21/1969	10/8/1969	Inactive; reportedly sanded out.
20	82 m (270 ft)	No Data	41 cm (16 in)	66 m (217 ft)	1893 lpm (500 gpm)	No Data	No Data	No Data	No Data	7/21/1969	9/20/1969	
21	78 m (255 ft)	81 m (266 ft)	41 to 35 cm (16 to 14 in)	39 m (127 ft)	2476 lpm (654 gpm)	None	No Data	No Data	No Data	No Data	3/1974	Used for irrigation only.
28	61 m (200 ft)	Spring	Spring	Spring	13,154 lpm (3,475 gpm)	Spring	Spring	Spring	Spring	Spring	Spring	

TABLE C-5, CHEMICAL ANALYSES OF GROUND WATER[1]

MAP[2] REFERENCE	WELL DEPTH	SAMPLING DATE	TEMPERATURE °C (°F)	MILLIGRAMS/LITER[3]: SILICA (SiO_2)	IRON (Fe)	CALCIUM (Ca)	MAGNESIUM (Mg)	SODIUM (Na)	POTASSIUM (K)	BICARBONATE (HCO_3)	CARBONATE (CO_3)	SULFATE (SO_4)	CHLORIDE (Cl)	FLUORIDE (F)	NITRATE (NO_3)	ORTHO-PHOSPHATE (PO_4)	DISSOLVED SOLIDS: CALCULATED	DISSOLVED SOLIDS: RESIDUE ON EVAP. AT 180°C	HARDNESS (as Ca CO_3)	SPECIFIC CONDUCTANCE (Micromhos at 25°C)	pH	COLOR
1	68.2 m	4/03/42	---	33	---	10	5.5	5.4	1.4	68	0	1.6	2.1	.1	0	---	93	86	48	116	---	---
	(224 ft)	11/10/47	10.5 (51)	34	5.1	14	7.5	---	---	64	0	24	2.6	.1	.1	---	---	118	66	158	7.3	---
		1/26/49	---	33	---	10	5.2	---	---	66	0	1.5	2.4	.1	.2	---	---	87	46	111	7.5	---
		4/18/51	11.6 (53)	31	.67	14	7.8	5.5	5.1	66	0	24	2.7	.2	.3	---	123	118	67	158	7.3	5
		7/23/52	12.7 (55)	31	.13	13	7.3	5.9	2.1	68	0	18	3.2	.1	.4	---	114	110	62	145	7.4	5
		9/10/53	11.6 (53)	33	.54	11	5.6	5.5	2.0	67	0	8.3	2.5	.1	.3	---	101	97	50	127	7.6	5
		9/13/54	11.6 (53)	32	8.1	12	6.3	4.9	2.3	64	0	13	2.8	.1	.2	---	105	98	56	137	7.2	5
2	72.8 m	4/03/42	---	31	---	10	5.8	5.4	1.4	70	0	1.7	2.0	.1	0	---	92	85	49	119	---	---
	(239 ft)	11/10/47	11.1 (52)	36	---	14	6.0	---	---	72	0	7.4	3.0	.1	.3	---	---	106	60	137	7.9	---
		5/26/50	12.2 (54)	9.2	.60	9.1	3.2	4.5	3.2	38	0	8.4	4.4	.4	.3	---	61	64	36	93	7.0	---
		5/02/51	11.6 (53)	30	1.1	9.8	5.2	5.0	4.5	70	0	1.6	2.3	.2	.1	---	93	85	46	138	7.6	3
		7/23/52	---	30	.09	9.4	6.2	5.2	1.6	68	0	1.9	2.5	.1	.1	---	91	88	49	114	7.3	5
		9/10/53	11.6 (53)	31	1.2	9.4	5.2	5.0	2.0	69	0	.8	2.0	.1	.2	---	90	85	45	110	7.6	3
		9/13/54	12.2 (54)	31	.86	9.6	5.6	4.3	1.5	68	0	1.6	2.5	.1	.1	---	90	81	47	111	7.4	5
		10/10/55	11.6 (53)	26	.43	11	4.7	5.5	1.7	67	0	3.5	2.8	.1	.7	---	89	88	47	120	7.3	15
3	69.7 m	11/10/47	10.5 (51)	31	.62	11	5.5	---	---	68	0	3.5	2.8	0	.2	---	---	89	50	117	7.5	---
	(229 ft)	1/26/49	---	21	---	11	4.1	---	---	59	0	3.6	3.3	.2	0	---	---	79	44	108	6.9	---
		5/26/50	12.2 (54)	31	7.1	11	5.7	4.5	4.5	65	0	3.4	3.2	.2	.2	---	96	95	51	119	7.3	---
		4/19/51	---	30	.94	11	5.2	5.0	4.2	69	0	2.6	2.9	.1	.3	---	96	92	49	115	7.4	10
		7/24/52	12.7 (55)	30	7.6	11	6.3	5.3	1.7	71	0	4.2	2.9	.1	.1	---	97	92	53	120	7.4	5
		9/10/53	11.1 (52)	33	.05	11	5.1	5.1	1.6	68	0	1.7	2.5	.1	.2	---	94	90	48	115	7.4	3
		9/13/54	11.1 (52)	27	1.5	12	6.2	4.7	1.1	66	0	3.5	3.2	.1	.2	---	91	88	55	118	7.1	10
		3/24/59	13.3 (56)	30	.66	12	5.3	5.1	1.7	70	0	3.0	3.0	0	.4	---	94	87	52	126	7.2	5
		10/26/59	11.1 (52)	31	.45	12	5.7	5.4	1.7	72	0	3.3	2.8	0	.1	---	97	92	54	131	7.4	5
5	301.7 m	5/27/50	11.6 (53)	46	8.4	5.8	3.8	4.6	4.3	43	0	4.2	3.0	.2	.1	---	94	90	30	80	7.1	---
	(990 ft)	4/18/51	12.2 (54)	42	.92	5.6	3.8	4.7	3.7	45	0	3.3	3.0	.1	.2	---	89	84	30	78	7.3	15
		7/24/52	12.7 (55)	42	2.5	6.4	4.4	4.9	2.1	46	0	3.9	2.1	.1	.2	---	89	86	34	80	7.5	5
		9/10/53	---	48	2.2	5.8	3.3	4.7	2.1	47	0	3.0	2.0	.2	.2	---	93	88	28	79	7.5	7
		9/13/54	11.6 (53)	43	1.4	6.4	4.4	4.2	.7	42	0	3.7	2.2	.1	.1	---	86	82	34	81	7.3	5
		10/10/55	12.2 (54)	39	.99	5.6	2.9	4.9	2.1	40	0	3.6	1.8	.1	.4	---	80	82	26	80	7.3	20
		10/26/59	12.2 (54)	42	5.2	6.0	3.0	4.4	2.4	42	0	3.3	2.0	0	.2	---	84	86	28	80	7.8	20
7	408.4 m	11/10/47	10.5 (51)	31	.02	12	6.5	---	---	70	0	5.5	3.8	.1	1.2	---	---	96	57	130	7.3	---
	(1,340 ft)	1/26/49	---	27	---	14	7.3	---	---	81	0	6.0	3.7	.1	3.2	---	---	115	65	156	6.8	---
		5/27/50	11.1 (52)	30	.03	13	7.2	5.2	2.2	78	0	5.9	3.6	.1	1.1	---	107	98	62	140	7.3	---
		4/18/51	11.1 (52)	26	.05	15	8.7	5.8	3.5	94	0	5.5	4.9	.1	1.9	---	118	109	73	164	7.3	3
		7/23/52	12.7 (55)	28	.18	13	7.7	5.7	2.0	84	0	6.0	3.5	.1	2.0	---	109	103	64	153	7.3	5
		9/10/53	11.6 (53)	27	.36	15	8.0	5.7	1.4	96	0	5.2	3.4	.1	1.2	---	114	103	70	163	7.2	3
		9/13/54	11.1 (52)	26	1.5	16	8.6	5.3	1.4	96	0	5.8	3.0	.1	.5	---	114	108	75	172	7.3	5
		10/10/55	10.5 (51)	24	.84	15	7.7	5.9	1.5	91	0	5.1	3.0	0	1.4	---	109	106	69	166	7.3	0
		11/06/56	10.5 (51)	23	.02	16	8.5	5.7	1.3	92	0	5.8	3.5	0	1.4	---	110	108	75	169	7.1	5
		1/13/58	11.6 (53)	22	.06	17	8.4	5.9	1.5	96	0	6.0	3.8	0	1.2	---	113	111	77	173	7.2	0
9	307 m	11/10/47	11.6 (53)	53	.06	7.8	5.2	---	---	66	0	2.6	2.3	.2	0	---	---	108	41	112	7.7	---
	(1,008 ft)	1/26/49	---	48	---	8.0	5.0	---	---	65	0	2.3	2.5	.1	.3	---	---	107	40	112	7.2	---
		5/26/50	11.6 (53)	42	---	9.4	5.9	7.1	3.7	70	0	4.1	2.7	.1	.2	---	110	107	48	121	7.7	---
		4/18/51	11.6 (53)	48	.44	7.8	5.0	7.2	5.3	68	0	3.1	2.4	.1	.2	---	113	104	40	113	7.7	5
		7/24/52	12.7 (55)	48	.06	8.4	6.2	7.1	2.6	66	0	3.5	3.0	.1	.1	---	112	106	46	115	7.4	5
		9/08/53	11.6 (53)	50	.13	8.2	5.4	7.2	2.5	73	0	2.9	2.2	.2	.1	---	115	106	43	116	7.5	3
		9/13/54	12.2 (54)	48	1.0	9.0	5.3	6.3	2.7	66	0	4.0	2.4	.2	0	---	110	101	44	117	7.3	5
10	11 m	11/10/47	10.5 (51)	23	0	12	3.9	---	---	36	0	15	8.2	.1	3.1	---	---	88	46	121	6.5	---
	(36 ft)	1/26/49	---	21	---	11	3.8	---	---	39	0	14	6.1	.1	2.0	---	---	83	43	118	7.5	---
		5/26/50	14.4 (58)	21	.03	10	3.6	4.7	2.2	38	0	13	4.8	.2	1.2	---	79	80	40	105	6.9	---
		7/23/52	13.3 (56)	21	.05	11	4.5	5.6	.8	40	0	14	5.0	.1	3.2	---	85	86	46	121	7.0	5
		9/10/53	11.1 (52)	22	.07	11	3.6	5.4	.7	42	0	13	4.7	.1	3.4	---	85	84	42	119	6.6	3
		9/13/54	10.5 (51)	21	.06	11	3.6	4.5	.7	36	0	15	4.9	.1	1.9	---	80	78	42	114	7.5	5
		10/10/55	10.5 (51)	19	.02	12	3.3	5.4	1.0	40	0	13	4.5	0	3.6	---	82	84	44	121	6.5	0
		11/06/56	10.5 (51)	17	.05	12	3.0	5.0	.6	38	0	15	4.5	0	1.5	---	78	81	42	117	6.3	0
		1/13/58	11.6 (53)	16	.04	12	3.7	5.4	.7	41	0	14	4.5	0	3.8	---	80	84	45	122	6.5	5

C. WATER RESOURCES (continued)

2. GROUND WATER

FORT LEWIS

MAP[2] REFERENCE	WELL DEPTH	SAMPLING DATE	TEMPERATURE °C (°F)	SILICA (SiO_2)	IRON (Fe)	CALCIUM (Ca)	MAGNESIUM (Mg)	SODIUM (Na)	POTASSIUM (K)	BICARBONATE (HCO_3)	CARBONATE (CO_3)	SULFATE (SO_4)	CHLORIDE (Cl)	FLUORIDE (F)	NITRATE (NO_3)	ORTHOPHOSPHATE (PO_4)	DISSOLVED SOLIDS CALCULATED	DISSOLVED SOLIDS RESIDUE ON EVAP AT 180°C	HARDNESS (as Ca CO_3)	SPECIFIC CONDUCTANCE (Micromhos at 25°C)	pH	COLOR
				MILLIGRAMS/LITER[3]																		
12	15.8 m	9/13/54	11.1 (52)	22	.10	9.6	3.0	3.9	.7	48	0	5.2	3.4	.1	.3	---	72	69	36	96	6.6	5
	(52 ft)	10/10/55	10.5 (51)	21	.09	9.9	2.9	4.7	.8	54	0	3.9	3.0	0	.3	---	74	73	37	103	6.7	0
28	Spring	11/10/47	11.6 (53)	11	.02	8.1	3.1	---	---	46	0	4.0	3.3	0	.3	---	---	55	33	87	6.9	---
		1/26/49	---	11	---	8.3	3.2	---	---	44	0	4.5	3.3	.1	.4	---	---	56	34	89	7.4	---
		5/31/50	12.2 (54)	11	.01	8.2	3.2	4.3	1.8	41	0	5.8	3.8	.1	.3	---	59	54	34	87	7.0	---
		4/18/51	12.2 (54)	8.4	.11	9.2	3.1	4.0	2.6	40	0	5.8	3.7	.1	.3	---	56	52	33	84	6.8	5
		7/24/52	12.7 (55)	8.1	.05	9.0	4.1	5.0	.8	48	0	5.8	3.8	.1	.4	---	61	60	39	93	7.0	5
		9/10/53	13.8 (57)	11	.04	8.5	3.2	5.0	.6	48	0	5.3	3.1	.1	.7	---	61	57	34	93	7.1	3
		9/13/54	13.8 (57)	11	.07	9.2	3.5	4.5	.7	44	0	6.6	3.8	.1	.1	---	61	56	37	95	6.6	
		10/10/55	---	10	.01	9.1	2.9	5.0	1.0	44	0	5.4	3.0	0	.4	---	59	57	35	95	6.8	0
		11/06/56	---	7.0	.05	8.5	3.3	4.8	.6	44	0	6.1	3.5	0	.1	---	56	55	35	94	6.8	5
		1/13/58	12.7 (55)	9.6	.05	9.7	2.9	4.9	.9	45	0	6.5	3.5	0	.8	---	61	58	36	98	6.8	0
		3/24/59	---	8.2	.03	9.0	3.3	4.8	1.0	46	0	6.2	3.5	0	.8	---	60	53	36	99	6.7	0
		9/13/60	12.2 (54)	11	.03	11	4.0	5.7	.9	57	0	6.4	3.0	.2	.7	---	71	71	44	117	6.7	0
(22)[4]	3 m (10 ft)	10/26/59	12.2 (54)	15	.08	14	4.2	5.8	1.3	59	0	11	3.5	0	2.5	---	86	82	52	134	6.8	5
(23)	408.4 m (1,340 ft)	11/10/55	10.5 (51)	24	0.84	15.0	7.7	5.9	1.5	91	0	5.1	3.0	0	1.4	---	---	106	69	166	7.3	0
(29)	Spring	1946	---	15	---	9.0	4.0	---	---	47	0	2.0	10.0	---	---	---	---	69	41	---	7.7	---
(24)	168 m (550 ft)	11/19/53	---	46	.08	7.6	5.0	7.8	1.7	66	0	2.0	1.6	.2	.2	---	---	99	40	110	7.8	3
(25)	305 m (1,000 ft)	9/13/54	11.6 (53)	43	.29	6.4	4.4	4.2	.7	42	0	3.7	2.2	.1	.1	---	---	82	34	81.0	7.3	5
(26)	73 m (239 ft)	9/13/54	12.2 (54)	31	.86	9.6	5.6	4.3	1.5	68	0	1.6	2.5	.1	.1	---	---	81	47	111	7.4	5
(27)	11 m (36 ft)	10/10/55	10.5 (51)	19	.02	12.0	3.3	5.4	1.0	40	0	13.0	4.5	0	3.6	---	---	84	44	121	6.5	0

[1]At Fort Lewis, the ground water used for water supply is of good quality. It is low in total dissolved solids and soft or only of moderate hardness. Silica, calcium, and bicarbonate are the principal dissolved constituents. Commonly, the iron concentration is undesirably high, and locally, orthophosphate concentrations are of concern. Fluoride is present in the natural waters but the content is less than optimum and additional fluoride is added before entering the distribution system. Treatment including settling and chlorination may take place at a booster station, or, in some cases, the water is chlorinated at the well. Water samples from the springs and wells are examined periodically for biological contamination by military medical personnel. Additional chemical analyses of water samples from wells numbers 1, 7, 14, 15, 19 and 20 dated 10 July 1972 are available at the Post.

[2]Numbers in parenthesis indicate indefinite locations; they are generally located to the nearest 40 acre quarter of a quarter-section (Township and Range land survey division).

[3]For purposes of this study, miligrams per liter (mg/l) may be taken to be roughly equivalent to parts per million (ppm).

[4]May be sample from Well No. 15, see Table C-4.

--- Not tested.

0 Tested but not present.

1. SURFACE WATER

CAMP BONNEVILLE

Lackamas Creek is a perennial stream that traverses Camp Bonneville in a southwesterly direction for approximately 7 kilometers (4.5 miles) and provides ample water for the needs of the installation. Discharge is estimated to be between 4,000 and 30,000 liters per minute (1,500,000 and 12,000,000 gallons per day). Greater flow is in the winter; lesser flow is in the summer and fall.

The water has good quality. There is little activity to pollute the water, which is low in dissolved solids. Water is pumped from Lackamas Creek and chlorinated at the pump for use at the Bonneville cantonment area. The tributaries in this subregion of the Columbia basin generally have low dissolved solids concentration, averaging less than 50 miligrams per liter, and the average hardness of water is less than 20 miligrams per liter. The small streams on Camp Bonneville probably have water with characteristics similar to these average values.

The small reservoir on Lackamas Creek, (see Camp Bonneville inset on Fort Lewis map) covers less than an acre when the gates are closed. The reservoir area is being developed for fishing, swimming, and picknicking. Buck Creek contains water only during the wet season. David Creek and the North and East Forks of Lackamas Creek have water all year, but their small sizes and the local terrain make them uneconomical for development.

2. GROUND WATER

CAMP BONNEVILLE

Little definitive information is available about the ground water at Camp Bonneville. Therefore, the accompanying ground water map (see inset on Fort Lewis map) has been categorized on the basis of rock types and their average water-bearing characteristics. However, these average characteristics are modified by the geologic forces which have acted on the rock during its geologic history, including the weathering regime during recent geologic time. The water-yielding properties of the rock, therefore, are the result of the type of rock and the forces which have acted upon it. Relatively speaking, only regional information is available for the Camp Bonneville area and the map categories are therefore generalized estimates. Field reconnaissance and test drilling would be necessary for more reliable map categories. In general, the water table would start to rise during the latter part of September or in October, remain high until March or April, and fall during the remaining months of the year. Highest and lowest levels vary from the average in any one year depending on the particular conditions during that year. All wells should be tested after development to determine the economic yield of the well and to acquire data on the maximum estimated yield of the aquifer. An analysis of the water should be made after the well has been completed. All wells should be protected from contamination by surface sources. Additional detail is provided in Tables C-6 and C-7, below.

TABLE C-6, GROUND WATER RESOURCES

MAP UNIT	QUANTITY AND SOURCE	DEPTH	QUALITY	DEVELOPMENT OF SOURCES
1	Moderate* to large quantities are generally available from wells. The underlying rock is the Upper Member of the Troutdale Formation, the Lower Member is absent. According to a Clark County study, the Upper Member is the important water-producing part of the Troutdale. Elsewhere in the county, wells sited in especially favorable locations have been reported to yield very large quantities, to as much as 11,355 lpm (3,000 gpm). The producing beds are a cemented gravel with scattered lenses and stringers of sand which are 90 to 120 m (300 to 400 ft) in thickness. The formation is about 90 m (290 ft) thick in the Camp Killpack well (see accompanying map and table) but its thickness elsewhere on the post is unknown. The Upper Member weathers to a silty clay which yields meager quantities of water. In places the entire section has been weathered and is relatively unproductive. The thickness of weathered Troutdale is difficult to judge from the driller's log of the Camp Killpack well. And elsewhere on post, the thickness of weathered material is unknown but it is expected to be significant. Presence of weathered material reduces the water yielding properties of the aquifer, but quantitative estimates are not possible from the data at hand. Springs have been reported in some of the draws, but locations and yields are unknown.	The well at Camp Killpack is the only well on the reservation. It passed through the entire thickness of the Troutdale Formation, 88 m (290 ft), but did not produce the desired amount of water, 265 lpm (70 gpm), until it had been extended into the underlying andesite for a total depth of 157 m (516 ft). According to a Clark County study, the 122 m (400 ft) water table contour crosses the Camp Bonneville area. This contour has been reproduced in modified form on the accompanying map. The ticks indicate that the surface of the water table slopes down to the south and west following the general topographic slope of the ground. Presence of the water table does not guarantee a water supply; yields depend on the permeability of the rock, and wells may have to penetrate deeply into the strata before obtaining an adequate supply. Elsewhere in Clark County, wells drilled into the Troutdale Formation range in depth to 122 m (400 ft) but maximum depths generally are about 60 m (200 ft). Dug wells generally are between 4.5 to 15 m (15 to 50 ft) deep.	The chemical quality of the water is reported as good for most uses. Chemical analyses of the water within the post are not available. However, elsewhere in the county, the water is reported to be low in total dissolved solids and the hardness ranges from soft (0 to 60 mg/l) to moderately hard (61 to 120 mg/l). A chemical analysis is available for the water from a well about 4 km west of the camp: T2N, R3E, Sec. 6K1 Grid Ref: 401588 Date: 5-17-49 Depth: 30 m (97 ft) Silica (SiO_2) 58 mg/l Aluminum (Al) — mg/l Iron (Fe) .01 mg/l Manganese (Mn) .00 mg/l Calcium (Ca) 14 mg/l Magnesium (Mg) 7.5 mg/l Sodium (Na) 5.7 mg/l Potassium (K) 4.0 mg/l Bicarbonate (HCO_3) 78 mg/l Carbonate (CO_3) — mg/l Sulfate (SO_4) .8 mg/l Chloride (Cl) 3.0 mg/l Fluoride (F) .2 mg/l Nitrate (NO_3) 5.4 mg/l Boron (B) .00 mg/l Dissolved solids 137 mg/l Hardness as $CaCO_3$ 66 mg/l Sodium-adsorption ratio 0.31 Specific conductance (micromhos at 25°C) 151 pH 7.0 A field determination of the hardness is also available for the water from a well about 0.5 km west of the camp:	Access to potential well sites would be moderately hindered by trees and moderate slopes. Wells generally would be drilled, cased, and screened, and would generally be less than 60 m (200 ft) deep. Wells sited on hilltops and slopes would have to be drilled deeper than wells located in the valleys. Where the Troutdale Formation is deeply weathered, yields might be unsatisfactory and it would be necessary to deepen the well into the underlying bedrock (see Map Unit 2 for maximum expected yields). For maximum yields, wells should be sited in favorable geological locations and drilled and developed by experienced personnel. Where only small supplies are necessary, large diameter dug or drilled wells 4.5 to 15 m (15 to 50 ft) deep may be adequate, even in fine grained or relatively impermeable weathered materials. However, the water level in shallow wells may fluctuate 1.5 to 3 m (5 to 10 ft) seasonally and wells may go dry in severe droughts.

2. GROUND WATER

CAMP BONNEVILLE

TABLE C-6, GROUND WATER RESOURCES (continued)

MAP UNIT	QUANTITY AND SOURCE	DEPTH	QUALITY	DEVELOPMENT OF SOURCES
			T2N, R3E, Sec. 4K1 Grid Ref: 436591 Date: Unknown, between 1949–55 Depth: 76 m (250 ft) Hardness as $CaCO_3$ 50 mg/l Tests for biological contamination of the ground water used on post are probably performed by Army personnel and results are presumed to be within acceptable limits.	
2	Generally small supplies available from volcanic lava flows, mostly andesite. The andesite ranges from medium texture to very fine-grained, is very commonly porphyritic, and is medium to brownish gray in color. The flow layers are interbedded with tuffs and breccias. In general, the fresh rock is dense and impermeable. Only a little water is stored in the joint systems. However, in places, the rock is weathered several tens of feet below the surface, and water is stored in the saturated subsoil. Under favorable conditions, moderate quantities of ground water would be available. A spring is present east of the confluence of David Creek and Lackamas Creek, and other springs are said to be present, but their location and yield are unknown.	Since these rocks occur in the more rugged and largely uninhabited part of the county, relatively few wells are described for the area. Dug wells in the weathered residuum are not expected to exceed 15 m (50 ft) in depth. Drilled wells in fresh bedrock may be extended to indefinite depths but, in practice, joints at depth tend to close because of the weight of the overlying rock, and contain less water. In general, most drilled wells will be less than 200 m (650 ft) deep. The 122 m (400 ft) water table contour is estimated to parallel the valley of Lackamas Creek. For the significance of this contour, to water supply, see the discussion under Map Unit 1, above.	The chemical quality of the water is expected to be good and suited for most uses. Ground water from deep wells may be expected to have a total dissolved solids content greater than water from shallow sources but still within the limits of good quality, i.e., total dissolved solids of less than 500 mg/l.	Access to potential well sites would be hindered by trees and moderate to steep slopes in places. In general, less drilling will be required to reach water if wells are located on lower slopes of hills or in the valleys. Geological assistance is recommended in siting potential wells, especially if the geological formations have been faulted or folded; structural changes may affect the yield of a well over short distances. Surface casing will be required for drilled wells, but in most instances, the remainder of the well will stand without casing. Dug wells in weathered rock will yield adequate quantities for small requirements but water levels will be affected by seasonal droughts and some wells may go dry.
3	Meager to small quantities of water may be expected from silty and clayey alluvium in the Lackamas Creek valley. Larger yields would be obtained if coarse sand or gravel are present. Yields would also be controlled by the thickness of the alluvium, greater yields being afforded where the alluvium is thicker.	No data is available on the total depth of alluvium. The upper 1.5 m (5 ft) is known to be fine-grained, predominantly silty clay with some gravelly clay. Possibly this may extend to depths of more than 3 m (10 ft). Below these fine-grained materials, coarse beds of sand and gravel may be present but the presence of such materials and the depth to which they may extend are problematical.	No analyses are available on the quality of the ground water. However, since the surface water is of good quality, it is assumed that the adjoining ground water is acceptable. It should be low in total dissolved solids, i.e., less than 500 mg/l and the hardness should be moderate, 61 to 120 mg/l.	Access would be easy to potential sites on the valley bottom. Sites selected near stream channels should be evaluated for risks of possible stream flooding. Wells may be dug or driven. Where sandy alluvium exists in continuity with the stream, water could be pumped from a trench excavated parallel to the stream. Pumping would induce water from the stream to flow into the trench; the intermediate sand would act as a filtering medium. If the intermediate area were composed of gravel, large quantities of water could be induced from the stream, reducing the amount of water available farther downstream. Where inadequate supplies are obtained from the alluvium, wells may be deepened into the Troutdale Formation or underlying andesite (see discussions under Map Units 1 and 2, above).

*Definitions of underlined terms are as follows:

	Liters Per Minute (lpm)	Gallons Per Day (gpd)
Large	400–4,000	150,000–1,500,000
Moderate	40–400	15,000–150,000
Small	4–40	1,500–15,000
Meager	<4	<1,500

TABLE C-7, WELL RECORDS

MAP REFERENCE	ELEVATION ABOVE SEA LEVEL	WELL DEPTH	DIAMETER OF WELL	STATIC LEVEL	YIELD	SPECIFIC CAPACITY	DEPTH OF AQUIFER	AQUIFER MATERIAL	PUMPING TEST	DATE WELL STARTED	DATE WELL COMPLETED	REMARKS
1	142 m (465 ft)	157 m (516 ft)	15.2 cm (6 in)	38 m (126 ft)	265 lpm (70 gpm)	No Data	153 to 157 m (503 to 516 ft)	Lava, 4 m (13 ft) thick	Pumped 3 hours at 265 lpm (70 gpm) with 9 m (30 ft) drawdown.	No Data	No Data	Located in Bldg T-4522. Well cased to 59 m (193 ft). Water pumped into a 37,852 liter (10,000 gallon) reservoir. See Table C-8, Killpack Well, for additional data.
2	Estimated 64 m (210 ft)	Estimated maximum 76 m (250 ft)	Proposed well, no data	Estimated less than 15 m (50 ft)	Estimated 113 to 378 lpm (30 to 100 gpm)	Proposed well, no data	Proposed well, no data	Proposed well, sand and gravel expected.	Proposed well, no data	Proposed well	Proposed well	Expected aquifer: sand and gravel of Troutdale Formation. Casing: Nominal 20.3 cm (8 in) diameter. Well screen: 4.6 m to 6.0 m (15 to 20 ft) of nominal 20.3 cm (8 in) diameter.

1. SURFACE WATER

YAKIMA FIRING CENTER

There are no flow measurements or reliable data concerning surface water at the Yakima Firing Center. Some rough estimates have been made based on informal reports of installation personnel. (See Table C-8 and accompanying map).

There is relatively little surface water on the reservation. The only perennial streams are short sections of Squaw Creek and Cold Creek near the reservation boundary. Other streams and the upper portion of these creeks are intermittent. The streams are most likely to be dry during the late summer. Some of the streams are spring-fed, particularly those perennial sections. There are many springs, however, that seep back underground and do not contribute to surface runoff. Much of the precipitation occurs as thunderstorms, resulting in heavy runoff for a short time and dry gullies for many weeks. The two largest intermittent streams are Selah Creek and Hanson Creek.

Presently there are two ponds which were developed to retain water which quickly disappeared under normal conditions: Taylor Pond and Kiddie Pond. Several other ponds that were constructed in past years have been abandoned.

There is plenty of water (far exceeding 40,000 liters per minute or 15,000,000 gallons per day) available in the Columbia River, which flows southward near the eastern boundary of the post. The post is separated from the Columbia River by the track of the Chicago, Milwaukee, St. Paul, and Pacific Railroad, except for two places where water in the river extends westward under the track into the reservation. The steep 500-foot bluff and rough topography on the firing center near the river, however, make it difficult to utilize water from the Columbia. If there were justifiable need, water could be pumped from the Columbia River without leaving the reservation. Before water can be taken from the river, however, a permit must be obtained from the State of Washington Department of Ecology.

Data are not available which describe the quality of surface water on the reservation. Some generalization can be made, however, about the probable quality of the waters based on the watershed conditions, present uses, and levels of activity. The State of Washington has designated the streams on the Center as Class A (Excellent) quality, which means they would be suitable sources of water supply for domestic, industrial, and agricultural uses. Military activities, cattle grazing, and range fires adversely affect existing water quality. Generally, however, the activities at the Yakima Firing Center do not cause water pollution problems.

TABLE C-8 SURFACE WATER RESOURCES

STREAM OR POND	LENGTH[1] OR AREA	ESTIMATED QUANTITY[2]	QUALITY[3]	DEVELOPMENT
Squaw Creek	15 km (9 mi)	Moderate to large* quantities of water estimated to be available near western reservation boundary. Perennial flow reported for 2 miles before leaving NW corner of post, with intermittent flow for 5 miles above that. Discharge roughly estimated at 40 to 1,000 liters/min, or 15,000 to 400,000 gallons/day except in the late summer.	Excellent. Primary sources are springs. No industrial pollution.	No stream development. There is an unimproved dirt road along the valley. Years ago there were several silica mines along the lower part of Squaw Creek.
Cold Creek	11 km (7 mi)	Moderate to large quantities of water estimated to be available near eastern reservation boundary. Perennial flow reported for 3 miles before leaving SE corner of post, with intermittent flow for 4 miles above that. Discharge is roughly estimated at 40 to 1,000 liters/min, or 15,000 to 400,000 gallons/day.	Excellent. Primary sources are springs. No industrial pollution.	Coffin Ranch Pond was built on Cold Creek about 10 years ago, but it was apparently destroyed by heavy runoff after a severe storm. A road also goes down the narrow valley where Cold Creek flows.
Selah Creek	34 km (21 mi)	Moderate quantities of water available mostly in winter and spring. Intermittent flow (40 to 400 liters/min, or 15,000 to 150,000 gal/day) except when dry or during storms or rapid snow melt. Probably dry at end of summer.	High quality. Primary sources are springs. No industrial pollution.	Taylor Pond was developed several years ago. An earlier reservoir farther downstream has been abandoned. Lower 10 km (6.2 mi) is a 122 m (400 ft) deep canyon with difficult accessibility. Above that, Selah Creek is in a broader valley with relatively good accessibility.
Hanson Creek	18 km (11 mi)	Moderate quantities of water available mostly in winter and spring. Intermittent flow (40 to 400 liters/min, or 15,000 to 150,000 gal/day) except when dry or during storms or rapid snow melt. Probably dry at end of summer.	High quality. Primary sources are springs. No industrial pollution.	No stream development. An unimproved dirt road runs along Hanson Creek; however, the valley is narrow and the topography is rough.
Alkali Creek	13 km (8 mi)	Moderate quantities of water available mostly in Spring. Intermittent flow. Generally dry except during spring snow melt and short periods after storms. Probably reaches 40 to 400 liters/min, or 15,000 to 150,000 gal/day during these periods.	High quality. Very little activity in the area that would cause pollution.	Flows in a deep, steep-sided valley where access is very difficult. There has been no development along the valley.

C. WATER RESOURCES (continued)

1. SURFACE WATER

YAKIMA FIRING CENTER

TABLE C-8, SURFACE WATER RESOURCES (continued)

STREAM OR POND	LENGTH[1] OR AREA	ESTIMATED QUANTITY[2]	QUALITY[3]	DEVELOPMENT
Taylor Pond	0.4 hectare (1 acre)	Moderate quantities of water available. Discharge from perennial spring into Taylor Pond is about 0.013 m³/sec (0.045 ft³ sec).	Water from spring is high quality. No industrial pollution. There may be some pollution by livestock if pond is used for watering.	This is a man-made pond developed one-half mile below a perennial spring in the bed of intermittent Selah Creek.
Kiddie Pond	0.2 hectare (0.5 acre)	No significant quantity. The pond dries up during the winter when irrigation system not operational.	High quality. Most of water comes from irrigation system.	Maintained primarily as a pond for children's fishing.

*Definitions of underlined terms are as follows:

	Liters Per Minute (lpm)	Gallons Per Day (gpd)
Large	400–4,000	150,000–1,500,000
Moderate	40–400	15,000–150,000

[1]Length within Yakima Firing Center.
[2]No field measurements available. Rough estimates of discharge are based on reported estimates of width, depth, and velocity of the streams.
[3]No surface water quality measurements available. Spring water is usually high quality when it emerges at the surface. Streams on installation have been classified as Class A (Excellent) quality, which are suitable as sources of water supply for domestic, industrial, and agricultural uses.

2. GROUND WATER

YAKIMA FIRING CENTER

Regional movement of ground water in Yakima Firing Center is toward the Columbia and Yakima Rivers. Local movement is down the flanks of upfold ridges (anticlines) into adjacent downfold valleys (synclines) and then toward the major rivers. Major synclines act as separate water basins, and hydraulic interaction between wells in the same syncline can occur over distances of several miles. Because alternate permeable and impermeable (confining) beds are folded as a unit, some wells in synclinal valleys are artesian; the three wells at Post Headquarters, for example, may flow part of the time (see Groundwater Resources Map).

The basaltic lava flows which underlie most of Yakima Firing Center are the reservoir rocks which contain the largest potential supply of ground water. Water moves and is stored in the permeable vesicular and weathered upper zones of the flows, in joints outlining polygonal columns, and in sandy and gravelly beds interlayered with the flows. Lateral permeabilities far exceed crossbed permeabilities; compact, relatively impermeable centers of flows create hydraulic discontinuities between permeable zones above and below. Springs are common on slopes where waterbearing strata are open to the surface because of jointing, faulting, or erosion.

Water is also abundant in the thick sequence of generally poorly consolidated, soft sedimentary rocks which flank some ridges and underlie adjacent valleys in the southwest part of the Center. Quantities are less where compaction and cementation have changed permeable sands and gravels to less permeable sandstones and conglomerates. Occasional lava flows interbedded with the sedimentary rocks have the same water-bearing characteristics as the flows discussed in the paragraph above. Layers of indurated silty volcanic ash (tuff) are poorly permeable and yield little water to wells. Insignificant quantities, at best, may be obtained from diatomite in Squaw Valley even though the permeability is high, because the deposits are thin and conditions for accumulation are not favorable.

A narrow belt of permeable sandy materials adjacent to the Columbia River near the northeast corner of the Firing Center may contain abundant ground water if the depth of the deposit and amount of inflow from the river are adequate. No thick deposits of unconsolidated recently valley-fill materials occur on the Center. Gentle lower slopes on the north side of Yakima Ridge and on both sides of Selah and Burbank Creeks north of Selah Butte Ridge are planed-rock surfaces (lava flows and sediments) capped by a thin veneer of gravelly materials; only very limited quantities of water are available from the gravelly veneer.

Water is least abundant in volcanic rocks of ridges, mesas, or knobs where free lateral outflow of water is possible.

TABLE C-9, GROUND WATER RESOURCES

	QUANTITY AND SOURCE	DEPTH	QUALITY	DEVELOPMENT OF SOURCES
1	Large* quantities available from unconsolidated recent silts and sands of bar-like floodplain of Columbia River where deposits are thick, continuous to the river, and recharged from the river. Buried channels of varying grain sizes and widths parallel the river and are open to infiltration from upstream. Unit bounded at the west by basalt cliffs and two alluvial fans; some infiltration locally from cliffs and through fans. One spring at west margin; probable seeps around toe of smaller fan. Unit thins toward the west; probably not thick anywhere.	Average depth to top of zone of saturation (water table) ± 30 m, (98 ft), ranging from 20 to 30 m (66 to 131 ft). Maximum yields increase to bedrock, probably $<$60 m (197 ft) below surface. Drawdown in wells would be only moderate, rebounding rapidly; static water level same as water table (no artesian head), fluctuating with river level controlled by Priest Rapids dam. No significant localized, extensive waterbearing strata (except possible coarse gravelly zone immediately above bedrock).	Ground water hard, but otherwise satisfactory for all uses. Quality similar to that of the Columbia River, but probably with some filtration of dissolved solids, slightly greater hardness from caliche soils and from recharge through bordering volcanic rocks, and possible addition of nitrates etc. from fertilization of irrigated fields to the east. No water-quality data are available for the Columbia River adjacent to Yakima Firing Center, but, in the general area, dissolved solids are less than 250 milligrams per liter (mg/l) and hardness is about 121 to 180 mg/l. No local sources of industrial or residential contamination.	Access to the unit is by railroad and unimproved road from both north and south. The entire unit is nearly level; the surface is generally firm, but sandy in places. Shallow dug or bored wells would produce limited quantities of water from buried channels above the water table, or from seepage inflow particularly through two alluvial fans at the west. All wells must be shored or cased to prevent collapse of unconsolidated materials, and should be screened and developed to reduce inflow of fine sands. An infiltration ditch at the toe of the smaller alluvial fan would collect small quantities of water seasonally.
2	Large quantities available from deep wells intersecting thick sequences of basaltic lava flows and associated interflow deposits. Well yields may be 378 liters per minute (lpm) [100 gallons per minute (gpm)] to more than 3780 lpm (1,000 gpm) they may average 3.6 to 5.4 lpm (1 to 1.5 gpm) for every foot of penetration below the water table. Yields from wells deeper than 100 m (325 ft) are relatively consistent, probably 1980 to 3780 lpm (500 to 1,000 gpm), varying significantly only in response to long-sustained periods (probably several months) of excessively dry or wet weather. Recharge to groundwater is almost entirely from precipitation, which averages 20 to 23 cm (8 to 9 in) per year; continued use of wells at maximum yields would rapidly deplete supply. (See Table C-10). Springs are numerous on lava ridges, flowing by gravity along permeable, vertically confined zones above the water table; 120 of them are developed for cattle and wildlife including 129 km (80 mi) of distributory pipelines). Quantities are not known, fluctuating with precipitation and snow-melting. Ground water moves through permeable zones in lava flows of the Yakima Basalt Formation, in sedimentary layers in and between the flows, and in flows included within the overlying younger, predominantly sedimentary Ellensburg Formation (see Introduction to table). Individual flows are 10 to 50 m (33 to 150 ft) thick. Sedimentary interlayers may aggregate less than five percent of the total thickness of the Yakima Basalt Formation, but carry a disproportionately large part of the water. Diversion or damming of ground water by cross-cutting geologic structures (e.g., faults, dikes) is relatively minor; the lavas were emplaced predominantly as extensive conformable sheets which were not strongly disturbed by subsequent geologic events.	The water table in westernmost Yakima Firing Center is presumed to be near the elevation of the Yakima River, which is approximately 335 m (1000 ft) west of Post Headquarters. The water table, thus, is 80 to 100 m (250 to 325 ft) below the surface in the valley which includes Post Headequarters, and probably at similar depths in the other synclinal valleys draining into the Yakima River. Static water levels in wells at Range Central and the Research Station suggest that the water table rises eastward from the river at a maximum gradient of about 4 m/km (8 ft/mi), about 1.5 m/km (3 ft/mi) less steeply than the ground surface. There is no information regarding water-table depths and gradients in valleys draining into the Columbia River. Levels will vary everywhere with amounts of seasonal precipitation and with irregularities in geologic structures. Ground water in wells at lower elevations of synclinal valleys may flow at the surface (e.g., at Post Headquarters) with greater than normal yields. Under anticlinal ridges, however, water may be far below the surface, with lower yields. Specific capacities of wells penetrating 200 m (600 ft) of saturated volcanic sequence and pumped at a discharge rate of 900 lpm (240 gpm) will be near 8.3 lpm (2.19 gpm) per foot of drawdown. Rebound, after pumping, to near the initial static water level will occur within two hours. Yields will increase with depth because more water-bearing zones will be intersected.	Generally good for domestic use. Hardness (principally calcium and magnesium) bothersome in most areas, particularly where water is from wells less than 150 m (500 ft) deep. Dissolved-solids content in water from wells less than 60 m (200 ft) deep may make supply unpalatable but not unhealthy. Contents of silica, iron, chloride, sulfate, sodium, and nitrate generally do not exceed recommended or acceptable limits. Fluoride may exceed optimum amounts locally; drinking supplies should be tested. Ground water from irrigated lands in the adjacent Yakima River valley probably will have greater hardness, more dissolved solids, and more of the chemical constituents associated with crop fertilization. Probable values of some water-quality parameters: Hardness—moderate; 80 to 165 mg/l in wells 150 to 180 m (500 to 600 ft) deep, less in deeper wells. Dissolved-solids content—generally less than 200 mg/l, higher in shallow wells, particularly if irrigation waters infiltrate below the water table. Silica-generally greater than 40 mg/l, increasing to about 60 mg/l at depths of 180 m (600 ft). pH-alkaline, to maximum of about 8.0. Specific conductance—generally slightly less than 250 micromhos, ranging to near 450 micromhos locally. (See Table C-11, Chemical Analyses, for data on Yakima Firing Center wells.)	Access to those parts of the unit in which wells are likely to be sited—bottoms and adjacent gently sloping lower slopes of the broader valleys, and low-elevation lava plains and terraces, for example—is easy except where there are bouldery outcrops and when deep snow obscures topographic microfeatures. The many areas of deep slopes and talus aprons, sharply incised gullies, and narrow ridges are difficultly accessible, but seldom are potential sites for ground water development. Springs are common on upper slopes of ridges. Developing their limited yields, generally for stock and wildlife watering, requires no mobile drilling equipment. Wells in the basalt are drilled, usually with down-the-hole hammer type rigs; drill foam helps float cuttings from the hole and decreases the weight of the water column above air-operated bits. Cementing during drilling will be required to prevent caving of loose zones and to prevent the hole from becoming so enlarged that cuttings will not be blown out. Wells should be cased, and the surface sealed, perhaps to a depth of about 10 m (30 ft). A down-the-hole hammer develops (cleans out) the well as it is drilled; final flushing for approximately an hour probably will give relatively clean water from most wells in basalt. The pumping rate is adjusted to stabilize the water level at a safe distance above the pump intake.
3	Moderate to large quantities available from deep wells in thick sections of poorly consolidated and unconsolidated sediments. Wells several hundred feet deep at favorable locations commonly yield 380 to 1140 liters per minute (lpm) [100 to 300 gallons per minute (gpm)], and at a few places 1900 to 3800 lpm (500 to 1000 gpm). Specific capacities of better wells range from 4 to 40 lpm (1 to 10 gpm) per foot of drawdown and rarely exceed 95 lpm (25 gpm). The materials of Map Unit 3 on Yakima Firing Center are essentially those of the lower Ellensburg Formation, consisting mostly of streamlaid volcanic-derived tuffaceous clays and pumice lapilli tuffs, siltstone, sandstone, and conglomerate, with an interlayered basalt flow about 30 m (100 ft) thick commonly exposed at the surface. The formation occurs only in the southwestern part of the Firing Center; eastward from the Yakima River along Selah Creek, for example, it thins and becomes nonexistent within three miles. Thicknesses of the formation on the Firing Center, therefore, are too limited for the potential large yields from the materials to be developed.	The water table in areas of the unit probably is 80 to 100 m (250 to 325 ft) below the surface (see discussion in Map Unit 2, DEPTH), and the maximum thickness of the sedimentary materials over the underlying basalts is about 165 to 180 m (500 to 600 ft). Wells in the thickest sequence of the unit, therefore, can penetrate no more than about 80 m (250 ft) of the sediments—too little to realize maximum yields. Static water levels in wells probably will be above the water table, reflecting some artesian pressure.	Generally good for domestic use. There are no data available on quality of water from wells entirely in sediments of the Ellensburg Formation and not influenced by infiltration of irrigation waters. Well No. 2 at Yakima Firing Center (see table of chemical analyses) has greater amounts of all constituents than do Wells No. 1 and 3 just to the east. Well No. 2 may indicate the chemistry of waters from Ellensburg Formation sediments with additions from a considerable thickness of alluvial cover, from a significant volume of irrigation infiltration, and from flow in basalt in the lowest part of the well.	Access is easy to those parts of the unit in which wells are likely to be sited—the valley bottom and adjacent gently sloping lower slopes and the alluvial plain in Headquarters Area and northward to Burbank-Creek. Well-drilling is generally easy; occasional strata of conglomerate or possible lava flow will slow drilling rate. Cementing may be required to stabilize some sandy layers. Wells should be cased, and the surface sealed. Wells must be developed (cleaned out) after drilling to remove excess fine-grained materials from water-bearing zones adjacent to wells.
4	Small to moderate quantities available from unconsolidated floodplain alluvium, alluvial fans, and pediment veneer. If uncemented, gravel and sand yield several hundred gallons per minute (gpm) where the zone of saturation is 8 to 15 m (25 to 50 ft) thick, and as much as 1900 to 3800 lpm (500 to 1000 gpm) where the zone is 15 to 30 m (50 to 100 ft) thick. Specific capacities commonly are 38 to 190 lpm (10 to 50 gpm) per foot of drawdown, and exceed 380 lpm (100 gpm) in some wells. Map Unit 4 is generally thin on Yakima Firing Center and is not an important ground water source. Both surface and ground water flow from the Center into the Yakima and Columbia Rivers; erosion has been dominant over deposition, resulting in stream incision, valley-side pedimentation of both Yakima and Ellensburg Formations, and stripping of softer sediments from underlying basaltic flows. There is some cementation, mostly calcium carbonate (caliche), in both the water-laid materials and in the windblown silts (loess) which commonly cover many areas. Small yields are available to support field exercises.	Unit 4 materials at Yakima Firing Center are not thick enough to extend below the regional water table, except, possibly, immediately west of the Headquarters area. They are saturated, therefore, only for a while after heavier rains and during snow melting. Very limited quantities of water may occur temporarily anywhere that impervious clays impede downward percolation (perched water).	Generally good for domestic use. Probably moderately hard at most places, but hard where calcium carbonate is excessive (caliche deposits). Dissolved-solids content high, becoming lower with increasing depth. Because Unit 4 materials are thin on Yakima Firing Center, surface waters contaminated by human or stock-animal occupation and use can occur if the permeability is not high.	Wells will be shallow if restricted to this thin unit, and must be cased and perforated or screened, developed (cleaned out) after drilling, and sealed at the surface. In some places, at toes of alluvial fans, for example, infiltration ditches will collect small amounts of potable water seasonally.

*Definitions of underlined terms are as follows:

	Liters Per Minute (lpm)	Gallons Per Day (gpd)
Large	400–4,000	150,000–1,500,000
Moderate	40–400	15,000–150,000
Small	4–40	1,500–15,000

C. WATER RESOURCES (continued)

2. GROUND WATER

YAKIMA FIRING CENTER

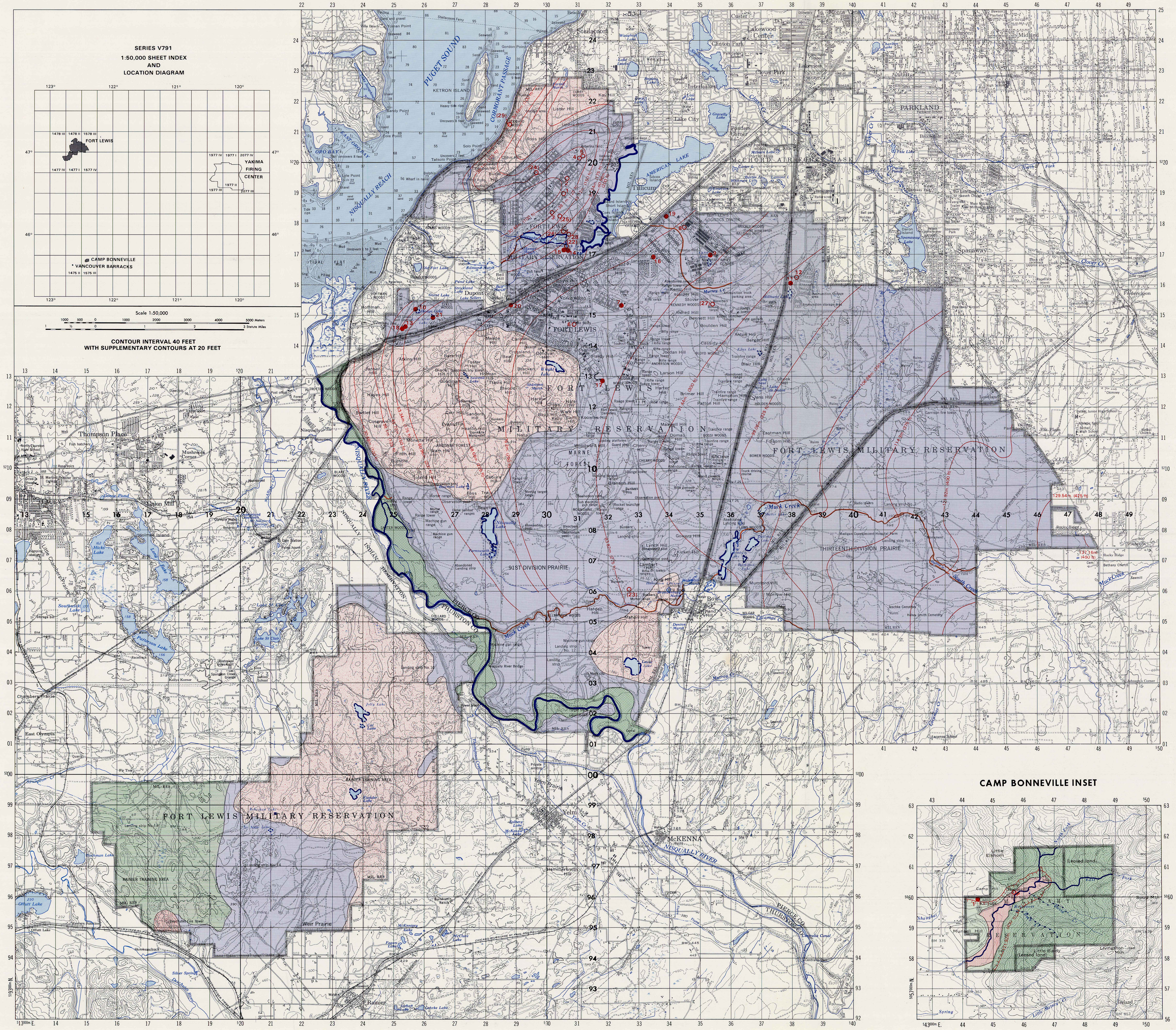
TABLE C-10, RECORDS OF WELLS

MAP REFERENCE	NAME	BUILDING NUMBER	DEPTH	YIELD	WATER LEVEL	REMARKS
1	Pomona Pump House	T-1961	183 m (600 ft)	2460 lpm (650 gpm)	9.1 m (30 ft)	
2	Marie's Pump House	T-1375	167 m (548 ft)	681 lpm (180 gpm)	7.3 m (24 ft)	
3	SE Well	T-1073	180 m (590 ft)	246 lpm (65 gpm)	26 m (85 ft)	
4			No Data	No Data	No Data	Privately owned well.
5	Research Station Well		183 m (602 ft)	379 lpm (100 gpm)	No data	
6	Range Central Well		94 m (310 ft)	151 lpm (40 gpm)	78 m (265 ft)	
7			No Data	No Data	No Data	Approximately 1/2 mile west of the former Pease Ranch.
8			82 m (270 ft)	No data	No Data	Section 15, T-14, R-20. Location approximate.
9	Selah Well		No Data	189 lpm (50 gpm)	No Data	Location approximate.
10	May be same as Selah Well		No Data	No Data	No Data	Location approximate.
11	Squaw Creek Well		No Data	38 lpm (10 gpm)	No Data	Location approximate.

TABLE C-11, CHEMICAL ANALYSES OF WELLS

					MILLIGRAMS PER LITER												DISSOLVED SOLIDS					
MAP REF	WELL DEPTH	WATER-BEARING MATERIAL	COLLECTION DATE	TEMP °C (°F)	SILICA (SiO_2)	IRON (Fe)	CALCIUM (Ca)	MAGNESIUM (Mg)	SODIUM (Na)	POTASSIUM (K)	BICARBONATE (HCO_3)	CARBONATE (CO_3)	SULFATE (SO_4)	CHLORIDE (Cl)	FLUORIDE (F)	NITRATE (NO_3)	CALCULATED	RESIDUE ON EVAP. AT 180°C.	HARDNESS (AS $CaCO_3$)	SPECIFIC CONDUCTANCE (MICROMHOS AT 25°C)	pH	COLOR
1	183 m (600 ft)	Basalt	4/20/51	21.1 (70)	56	.04	15	11	19	6.2	151	0	.7	4.1	.5	0	187	179	83	235	8.0	4
			9/29/53	21.1 (70)	59	.15	16	11	19	3.6	149	0	.7	3.8	.5	.1	187	176	85	244	7.8	4
			11/29/54	17.8 (64)	53	.06	16	11	19	3.6	148	0	1.8	4.4	.5	.7	183	172	85	235	7.6	7
			10/05/55	20.0 (68)	50	.08	16	9.4	19	4.0	147	0	.2	3.5	.5	0	175	173	79	238	8.1	0
			10/25/56	19.4 (67)	49	.06	15	11	19	3.5	149	0	.7	4.0	.4	.2	176	174	83	234	7.8	0
			1/06/58	20.0 (68)	—	.03	16	10	18	3.6	147	0	.3	4.0	.5	0	—	171	81	236	7.8	0
			3/30/59	20.0 (68)	51	.05	17	11	18	4.0	146	0	.5	3.5	.6	.3	178	174	87	239	7.8	5
			9/14/60	20.0 (68)	52	.04	15	11	19	3.7	147	0	.8	4.0	.6	.2	178	174	82	220	7.9	0
2	167 m (548 ft)	Basalt	4/20/51	18.31 (65)	50	.05	35	19	32	7.2	246	0	2.3	9.2	.6	2.0	299	284	165	429	7.7	3
			9/18/52	17.2 (63)	50	.12	25	15	27	4.1	198	0	1.2	6.4	.5	.5	238	231	124	344	7.6	2
			9/29/53	16.1 (61)	53	.20	36	18	32	4.5	239	0	2.3	8.8	.6	3.8	297	293	164	441	7.5	8
			11/29/54	15.6 (60)	48	.12	33	17	31	4.4	218	0	2.1	9.2	.5	8.5	280	272	152	425	7.3	6
			10/05/55	15.0 (59)	45	.08	34	17	30	4.4	222	0	2.1	9.2	.6	8.1	277	280	155	432	7.7	0
3	180 m (590 ft)	Basalt	9/17/52	18.9 (66)	52	.11	17	10	22	4.5	154	0	1.2	4.3	.5	.2	188	178	84	246	7.9	3
			11/29/54	16.7 (62)	49	.86	17	10	21	4.6	154	0	1.4	4.9	.5	.7	185	183	84	249	7.7	8
			10/05/55	17.2 (63)	49	.27	17	9.3	20	4.3	151	0	.2	4.5	.5	.2	179	175	81	247	7.7	0

—Not tested
0 Tested but absent



FORT LEWIS, WASHINGTON

(Including Camp Bonneville, Vancouver Barracks and Yakima Firing Center)

TERRAIN ANALYSIS

WATER RESOURCES

FORT LEWIS

SURFACE WATER

FRESH WATER PERENNIALLY PLENTIFUL

Enormous quantities available all year from the Nisqually River and American Lake.

Very large quantities available all year from spring-fed Clear Creek and a short channel of the Nisqually River.

Large quantities available from lakes all year at this rate of withdrawal.

Moderate quantities available from small lakes all year at this rate of use.

Small quantities available from small lakes and ponds throughout the year; could get greater quantities for short periods of time.

FRESH WATER SEASONALLY PLENTIFUL

Very large quantities available most of the year from Clear Creek, Murray Creek, and other short portions of streams. Segments of these may be dry in the late summer.

Large quantities available for about half the year, but stream may be dry in the summer and early fall.

GROUND WATER

FRESH WATER GENERALLY PLENTIFUL

1. Moderate to very large quantities. Some thick deposits of glacial outwash.

FRESH WATER LOCALLY PLENTIFUL

2. Small to large quantities from alluvium.

3. Meager to moderate quantities mixed glacial deposits.

FRESH WATER SCARCE OR LACKING

4. Meager to small quantities from volcanic rocks.

5. Meager to small quantities from glacial till.

76.2m. (250 ft) Vertical distance of water table above mean sea level. (Data not available for southwest portion of installation.)

Active well.

Inactive or abandoned well.

Spring

Number refers to entry in table.

WATER RESOURCES

CAMP BONNEVILLE

SURFACE WATER

FRESH WATER PERENNIALLY PLENTIFUL

Very large quantities available throughout the year from Lackamas Creek, greatest in the winter and spring.

FRESH WATER SEASONALLY PLENTIFUL

Small quantities available all year from David Creek and in the winter and spring from Buck Creek.

GROUND WATER

FRESH WATER LOCALLY PLENTIFUL

1. Moderate to large quantities, uncommonly as much as very large from weakly consolidated sands and gravel.

2. Small, in places moderate quantities from hard, fractured volcanic rocks.

FRESH WATER SCARCE OR LACKING

3. Meager to small quantities from shallow alluvium.

121.92m. (400 ft) Vertical distance of water table above mean sea level. Hachures point down the slope of the water surface; approximated.

Active well.

Proposed well.

Number refers to entry in table.

DEFINITION OF VOLUME TERMS USED

Volume Term	Liters Per Minute (lpm)	Gallons Per Day (gpd)
Enormous	>40,000	>15,000,000
Very Large	4,000 to 40,000	1,500,000 to 15,000,000
Large	400 to 4,000	150,000 to 1,500,000
Moderate	40 to 400	15,000 to 150,000
Small	4 to 40	1,500 to 15,000
Meager	<4	<1,500

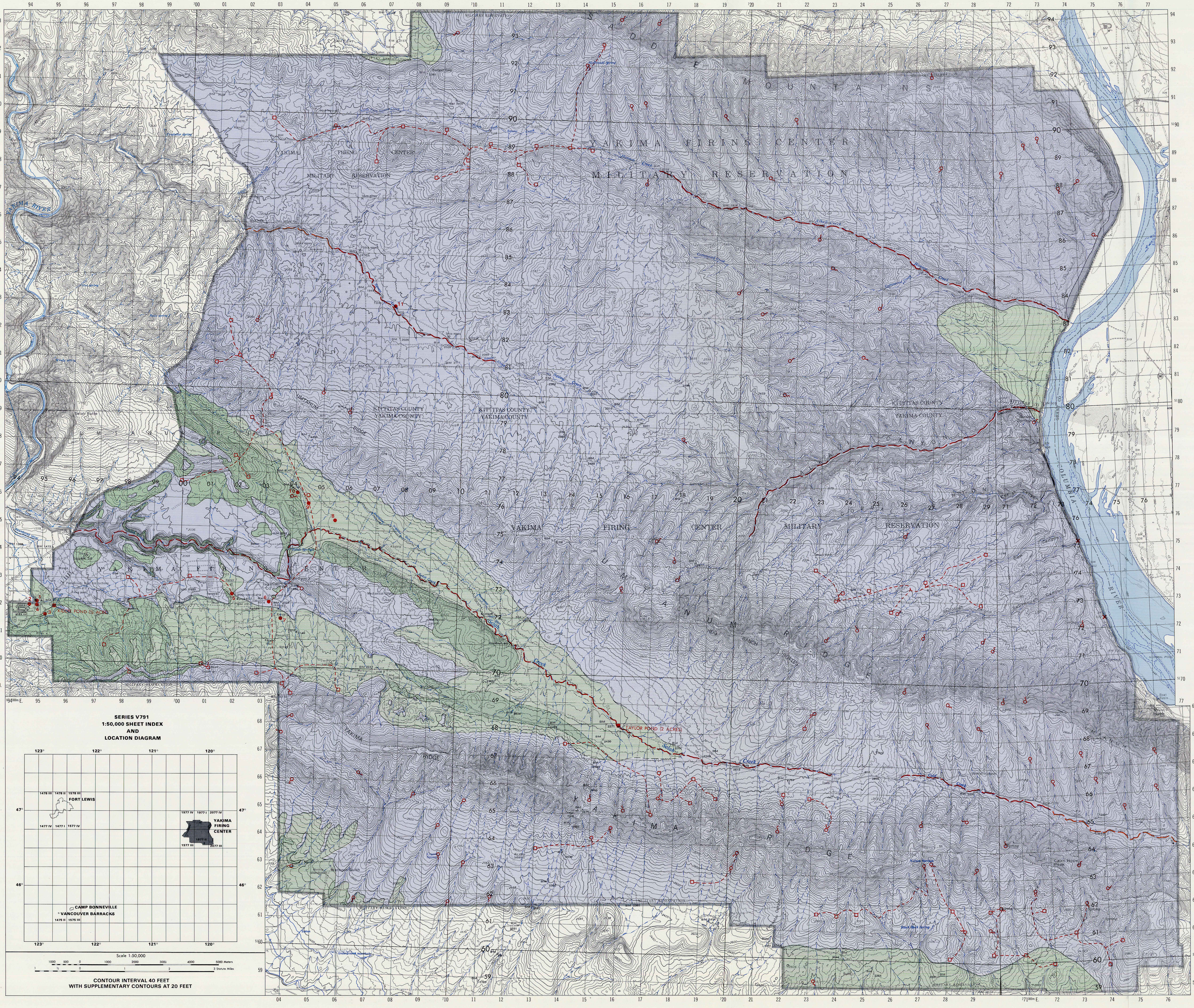
USER NOTE: For permissible concentrations of impurities in military water supplies, see Department of the Army Technical Manual TM 5-700, *Field Water Supply*, July 1967, paragraph 19, or other applicable manuals or regulations.

Prepared by the Terrain Analysis Center, U. S. Army Engineer Topographic Laboratories, Fort Belvoir, Virginia, March 1977. Cartographic and Reproduction Support by the Defense Mapping Agency Hydrographic/Topographic Center, Washington, D C. December 1978.

FORT LEWIS, WASHINGTON

(Including Camp Bonneville, Vancouver Barracks and Yakima Firing Center)

TERRAIN ANALYSIS



WATER RESOURCES

YAKIMA FIRING CENTER

SURFACE WATER

FRESH WATER SEASONALLY PLENTIFUL

Moderate to large quantities available during most of year. Moderate quantities available during dry season in late summer.

FRESH WATER SCARCE

Moderate quantities available most of the year, but dry part of the year.

LIMITED WITHDRAWAL

Inlet where water in Columbia River extends westward under railroad track into military reservation. Water withdrawal only by permit of state.

Manmade Ponds.

GROUND WATER

FRESH WATER GENERALLY PLENTIFUL

1. Large quantities from Columbia River floodplain silts and sands.

2. Large quantities from thick sections of basaltic lava flows.

FRESH WATER LOCALLY PLENTIFUL

3. Moderate to large quantities from thick sections of poorly consolidated and unconsolidated sediments.

4. Small to moderate quantities from floodplain alluvium, alluvial fans, and pediment veneer.

Location of water quantity boundary relatively accurate.

Location of water quantity boundary interpreted from topography.

1 Well

Springs developed, often with waterpipes, to supply holding tanks or troughs for stock and wildlife. Data as of July, 1976. (There are numerous other springs generally in same areas that are not shown).

Water trough

Buried water pipeline.

Number refers to entry in table.

DEFINITION OF VOLUME TERMS USED

Volume Term	Liters Per Minute (lpm)	Gallons Per Day (gpd)
Large	400 to 4,000	150,000 to 1,500,000
Moderate	40 to 400	15,000 to 150,000
Small	4 to 40	1,500 to 15,000

USER NOTE: For permissible concentrations of impurities in military water supplies, see Department of the Army Technical Manual TM 5-700, *Field Water Supply*, July 1967, paragraph 19, or other applicable manuals or regulations.

Prepared by the Terrain Analysis Center, U. S. Army Engineer Topographic Laboratories, Fort Belvoir, Virginia, March 1977. Cartographic and Reproduction Support by the Defense Mapping Agency Hydrographic/Topographic Center, Washington, D. C. December 1978.

D. ENGINEERING SOILS

FORT LEWIS

Soils on the Fort Lewis Reservation range from excessively drained, very gravelly and cobbly sands developed from glacial till to highly organic peat and muck soil which occur in some of the depressions and other very poorly drained areas. In general, the glacially derived soil material is many tens of meters thick. Most soils on the reservation are slightly acid to strongly acid in the surface soil, but with increasing depth, become less acid. Except for the peats and mucks, most soils are low in organic matter. However, some soils, especially those with a forest cover, have a very thin surficial layer of partly decomposed organic matter a few centimeters thick.

The most extensive soils on the reservation are the Everett and Spanaway soils comprising most of map unit 1. They have developed on nearly level to rolling glacial outwash deposits composed of poorly sorted gravels and sands with varied amounts of cobbles. These soils are somewhat excessively drained; runoff is slow due to the porous nature of the soil. Sand and gravel suitable for many construction uses occur in abundant quantities.

Other soils include sandy bottomland soils covering most of the Nisqually River floodplain and very poorly drained organic soils in scattered swampy depressions or basins. The floodplain soils commonly have a very dark gray fine sand or fine sandy loam surface layer of about 20 centimeters thick. The subsoil and substratum continues as a sand or sandy loam but with increasing depth, lenses or stratified layers of coarse-textured materials become common. These soils are subject to seasonal flooding unless diked. Thus their suitability for many engineering uses is severely limited. For cropland, these are potentially some of the best soils in the area.

The very poorly drained organic soils are scattered throughout the reservation but their total area is not large. In terms of the Unified Soil Classification System used by the U.S. Army Corps of Engineers, most of these soils are classified as Pt (peat) or OL (organic silt). They are unsuited for most engineering uses. However, if drained the organic soils are highly productive.

All soils occuring on slopes of 15 percent or more have been grouped in map unit 6. Slopes of this magnitude impose severe limitations for most engineering soil uses.

TABLE D-1, SOIL CHARACTERISTICS AND SELECTED EVALUATIONS

MAP UNIT	MAJOR SOIL SERIES[1]	GEOGRAPHIC SETTING	TYPICAL SOIL PROFILE LAYERS, THICKNESS AND COLOR OF LAYERS[2], DEPTH TO ROCK AND UNIFIED ENGINEERING CLASSIFICATION[3] (PROFILE NOT TO SCALE)		HIGH WATER TABLE DEPTH (METERS) AND DURATION (MONTHS)	PERMEABILITY CENTIMETERS/HOUR OR (INCHES/HOUR)	RATING AND MAJOR KINDS OF LIMITATIONS FOR:[4] SHRINK-SWELL POTENTIAL	SEWAGE LAGOONS	SEPTIC TANK FILTER FIELD	FOUNDATIONS FOR SMALL BUILDINGS	ROAD LOCATION	SHALLOW EXCAVATIONS	TRAFFICABILITY	BIVOUAC SITES	REMARKS
1	Spanaway Everett	Nearly level to gently rolling upland plains. Slopes range up to 15 percent; most between 2 and 6 percent. Dominant soils developed in glacial outwash deposits.	cm SM,GM 30 SM GP-GM 80 GP-GM SP 180+	Very dark brown to black gravelly sandy loam. Dark grayish brown to dark yellowish brown very gravelly coarse sandy loam. Commonly contains up to 60 percent gravel and/or cobbles in lower part. Brownish gray very gravelly sand. High content of gravel and/or cobbles as layer above.	None (more than 1.8 m)	5.0 to 15 cm/hr (2.0 to 6.0 in/hr) 15 to 50 cm/hr (6.0 to 20 in/hr) below 80 cm in depth	Very low	Severe (s)	Slight	Slight	Slight	Moderate (c)	Slight	Slight	Total soil depth up to 100 meters. In the extreme southwest part of reservation, a few limited soil areas only 1 to 2 meters (3.2 to 6.5 feet) thick; these derived from shale and sandstone.
2	Alderwood Sinclair	Undulating to rolling knolls and moraines; most slopes between 3 and 15 percent. Soils derived from gravelly till.	cm GM 15 GM 90 GM GP,SM 180+	Yellowish brown gravelly loam. Yellowish brown gravelly loam containing many hard concretions. Layer contains 30 to 45 percent gravel. Very compact, weakly to strongly cemented, gravelly and/or sandy unassorted glacial till.	0.75 to 0.90 m Jan to Mar (perched water table)	1.5 to 5.0 cm/hr (0.6 to 2.0 in/hr) Less than 0.15 cm/hr (0.06 in/hr) in cemented till.	Low	Severe (w)	Severe (n,w)	Slight	Slight	Moderate (w,n)	Slight	Slight	In the natural state, soil commonly covered by a thin layer of forest litter and leaf mold. This layer also present in other forested soils.
3	Giles Kitsap	Smooth, nearly level to rolling plains on outwash terraces; most slopes between 3 and 10 percent.	cm ML 25 CL 120 ML,SM 180+	Dark yellowish brown silt loam or fine sandy loam. Olive brown silty clay loam. Layer contains some hard concretions in upper part. Highly varied but chiefly stratified, olive brown silt, fine sand and loamy sand.	None (more than 1.8 m)	1.5 to 5.0 cm/hr (0.6 to 2.0 in/hr) 0.5 to 1.5 cm/hr (0.2 to 0.6 in/hr) in CL layer.	Low to Moderate	Slight to Moderate (h)	Severe (p)	Moderate (t,a)	Moderate (t,a)	Slight	Moderate (t)	Slight	
4	Pilchuck Puyallup	Nearly level floodplains; slopes less than 3 percent. Soils formed in alluvium.	cm SM 20 SM SP 95 SP,SM,GP 180+	Very dark gray fine sand; loose. Dark grayish brown loamy fine sand or fine sand; loose. Very dark gray gravelly sand and silty sand commonly stratified. Each soil component not present everywhere. Layers occur in varied sequence and thickness.	More than 1.2 m Dec to Apr	5.0 to 15 cm/hr (2.0 to 6.0 in/hr) 15 to 50 cm/hr (6.0 to 20 in/hr) below 20 cm	Very low	Severe (f)	Severe (f,w)	Severe (f)	Severe (f,w)	Severe (f,w,c)	Severe (f)	Moderate to Severe (f,w)	Unit includes areas of riverwash sand and gravel containing cobbles and small boulders. Evaluations for use are upgraded in areas protected from floods.
5	Bellingham Tisch	Level to nearly level depressions on uplands and along drainageways; slopes generally less than 2 percent. Soils chiefly developed in alluvium.	cm ML,OH 25 CL CH 120 GC 180+	Dark gray to black silt loam. Gray to olive gray plastic silty clay; mottled in upper part. Gravelly clay till; not present everywhere.	0.15 to 0.6 m Dec to Jun	0.5 to 1.5 cm/hr (0.2 to 0.6 in/hr) in upper layer 0.15 to 0.5 cm/hr (0.06 to 0.2 in/hr) in CL or CH layer.	Low in upper layer. High in CL or CH layer.	Severe (w)	Severe (w,f,p)	Severe (w,f,t)	Severe (w,f,t)	Severe (w,f)	Severe (w,f)	Severe (w,f)	The Tisch soil series member of this map unit has formed in material mainly of diatomaceous earth, volcanic ash and muck with a thin surficial layer of alluvium.
6	.... (Undifferentiated gravelly and sandy soils that generally occur on the steeper slopes)	Areas of steep or broken land along drainageways, on escarpments or bluffs and on unassorted morainic deposits. Slopes up to 60 percent; most between 15 and 25 percent.	cm GM,SM 20 GP-GM SP-SM 180+	Dark brown gravelly sandy loam; contains small cobbles. Light brown very gravelly sandy loam to very gravelly loamy sand. This zone contains many cobbles.	None (more than 1.8 m)	5.0 to 15 cm/hr (2.0 to 6.0 in/hr) in upper layer. 15 to 50 cm/hr (6.0 to 20 in/hr) below 20 cm.	Low to Very low	Severe (h,s)	Severe (h)	Severe (h)	Severe (h,r)	Severe (h,r,c)	Severe (h)	Severe (h)	Most areas in this map unit remain in coniferous forest.
7	Mukilteo Semiahmoo Rifle	Very poorly drained depressions, flats and swamps; slopes between 0 and 2 percent.	cm Pt 30 Pt OL 180+	Dark gray to black organic matter in various stages of decomposition. Black to dark reddish brown peat and/or muck, in places mixed with mineral materials.	0.0 to 1.0 m Nov to May	5.0 to 15 cm/hr (2.0 to 6.0 in/hr)	Low	Severe (w,f,o)	Severe (w,f,o)	Severe (w,f,t,o)	Severe (w,f,t,o)	Severe (w,f,o)	Severe (w,f,t,o)	Severe (w,f,t)	Organic materials mainly accumulated from sedges, grasses and some wood, including partly decomposed logs. Thickness of peat and muck as much as 6 meters (20 feet). Unless artificially drained, areas are normally ponded during rainy seasons.

[4]DEFINITION OF RATING TERMS

SLIGHT-relatively free of limitations or limitations are easily overcome.
MODERATE-limitations can be overcome with good planning and/or careful design.
SEVERE-limitations are serious and are difficult to overcome.

SOIL RELATED PROPERTIES AFFECTING LIMITATIONS

a-high shrink-swell	p-percolates slowly
c-cutbanks cave	r-stony or shallow soils
f-floods	s-seepage porous soil
h-slope	t-low strength
n-cemented pan	w-wetness or high water table
o-high in organic matter	

[1]Soils that have profiles almost alike make up a soil series. The series is the common name of the soil. Each series is named for a town or other geographic feature near the place where a soil of that series was first observed and mapped. Many other minor soils are included in the map unit.
[2]Total thickness of unconsolidated soil material varies from place to place. Generally, depth to bedrock is many tens of meters on the Fort Lewis Military Reservation.
[3]The Unified Soil Classification System, Technical Memorandum No. 3-357, U.S. Army Corps of Engineers, March 1953.

CAMP BONNEVILLE

Upland soils on the Camp Bonneville Military Reservation have mainly developed from basalt. Most are gravelly or stony and fairly shallow. Bottomland soils along Lackamas Creek are clayey and may have a seasonal high water table. The suitability of soils for construction or other engineering use is limited mainly by steep slopes on uplands and potential seasonal wetness on bottomlands.

Detailed information concerning the distribution, characteristics and behavior of different kinds of soil can be obtained from the Soil Conservation Service, U.S. Department of Agriculture. Offices in proximity of Fort Lewis are in Puyallup and Olympia, WA.

TABLE D-2, SOIL CHARACTERISTICS AND SELECTED EVALUATIONS

MAP UNIT	MAJOR SOIL SERIES[1]	GEOGRAPHIC SETTING	TYPICAL SOIL PROFILE LAYERS, THICKNESS AND COLOR OF LAYERS[2], DEPTH TO ROCK AND UNIFIED ENGINEERING CLASSIFICATION[3] (PROFILE NOT TO SCALE)	HIGH WATER TABLE DEPTH (METERS) AND DURATION (MONTHS)	PERMEABILITY CENTIMETERS/HOUR OR (INCHES/HOUR)	SHRINK-SWELL POTENTIAL	RATING AND MAJOR KINDS OF LIMITATIONS FOR:[4] SEWAGE LAGOONS	SEPTIC TANK FILTER FIELD	FOUNDATIONS FOR SMALL BUILDINGS	ROAD LOCATION	SHALLOW EXCAVATIONS	TRAFFICABILITY	BIVOUAC SITES	REMARKS
1	McBee Cove	Level to very gently sloping floodplains and flat depressional areas. Most slopes less than 3 percent. Soils formed from alluvium weathered from sedimentary and basic igneous rocks. Soils very poorly to moderately well drained.	cm CL — Very dark brown silty clay loam. 25 CL CH — Dark grayish brown clay loam to dark gray clay. 180+	0.3 to 0.75 m Dec-Apr	1.5 to 5.0 cm/hr (0.6 to 2.0 in/hr)	High to Moderate	Moderate (w,f)	Severe (p,w)	Severe (a,w,f)	Severe (f,w,a)	Moderate (w,f)	Severe (t,f)	Severe (w,f)	Very poorly drained soils may occasionally be ponded unless artificially drained.
2	Olympic Hesson	Gently to steeply sloping mountain foot-slopes and upland terraces including local ridgetops and benches. Slopes range between 3 and 30 percent. Soils mainly developed from basalt and are well drained.	cm ML — Reddish brown clay loam. CL — Reddish brown clay loam or clay. In many places layer contains gravel or rock fragments. 110 CL CH GC 140 Fractured basalt bedrock.	None	0.5 to 1.5 cm/hr (0.2 to 0.6 in/hr)	High to Moderate	Slight to Severe (h)	Severe (p,h)	Moderate (h,a)	Moderate to Severe (h,t)	Moderate (h,r)	Moderate (t)	Slight to Moderate (h)	Basalt bedrock commonly occurs at depths ranging from 100 to 180 cm. Soils in terrace positions are generally deeper.
3	Hesson (gravelly phase)	Nearly level to strongly sloping upland terraces along mountain footslopes. Maximum slopes about 20 percent; most around 6 to 12 percent. Soils developed in well weathered, mixed alluvium derived from basaltic and quartzitic rocks.	cm GC — Dark reddish brown gravelly clay loam. 55 GC CH — Dark reddish brown gravelly clay. 180+	None	1.5 to 5.0 cm/hr (0.6 to 2.0 in/hr) in upper layer. 0.5 to 1.5 cm/hr (0.2 to 0.6 in/hr) in lower layer.	Moderate	Moderate (h)	Moderate (h,p)	Moderate (h)	Moderate (h)	Severe (r)	Slight to Moderate (h)	Slight to Moderate (h)	Gravels are dominantly of quartzitic composition.
4	Olympic (stony phase)	Steep, long slopes of mountains and foothills including short slopes that lead into drainageways. Most slopes between 30 and 60 percent. Soils underlain by basalt. Most soils formed in place but locally, developed in material moved by gravity.	cm CL — Dark reddish brown stony clay loam. 10 GC — Reddish brown to yellowish red gravelly clay loam. 40 Partly weathered or fractured basalt bedrock.	None	Highly varied but mostly 0.5 to 1.5 cm/hr (0.2 to 0.6 in/hr)	High	Severe (h,r)	Severe (h)	Severe (h)	Severe (h)	Severe (h,r)	Severe (h)	Severe (h)	Content of coarse fragments incorporated with soil ranges from 0 to about 35 percent. Surface runoff is very rapid; hazard of erosion very severe if surface left bare.

[1]Soils that have profiles almost alike make up a soil series. The series is the common name of the soil. Each series is named for a town or other geographic feature near the place where a soil of that series was first observed and mapped. Many other minor soils are included in the map unit.
[2]Total thickness of unconsolidated soil material varies from place to place.
[3]The Unified Soil Classification System, Technical Memorandum No. 3-357, U.S. Army Corps of Engineers, March 1953.

[4]DEFINITION OF RATING TERMS

SLIGHT-relatively free of limitations or limitations are easily overcome.
MODERATE-limitations can be overcome with good planning and/or careful design.
SEVERE-limitations are serious and are difficult to overcome.

SOIL RELATED PROPERTIES AFFECTING LIMITATIONS

a-high shrink-swell	p-percolates slowly
f-floods	r-stony or shallow soils
h-slope	t-low strength
	w-wetness or high water table

YAKIMA FIRING CENTER

Soils on the Yakima Firing Center have been grouped into five map units. The map and the descriptions and data contained in this table are based on agriculturally-oriented soil surveys performed by the U.S. Department of Agriculture. The map is highly generalized since detailed soil information, such as usually performed in irrigated areas, is generally lacking. For information concerning a specific site or otherwise small area, on-site inspection and testing is required.

The profile diagrams depict the representative composition and sequence of major horizons (layers) of the dominant soils in each map unit. The soils depicted as typical and dominant in one map unit may also occur in other units.

Soils of the Yakima Firing Center range from limited areas of deep, well-drained alluvial loams covering bottomlands to extensive areas of shallow, stony, upland soils overlying basalt. The development and properties of soils on the Center have been, more or less, influenced by loess, a silty wind-blown deposit. The loess is not of uniform thickness. In some cases it is many meters thick, but in other places erosion has stripped away the deposit leaving a very thin or discontinuous cover or exposed bedrock.

The most extensive soils are those grouped in Map Unit 5. Dominant soils in this unit are the shallow Rock Creek and Starbuck series. They occur on nearly level to very steep upland slopes of ridges and plateaus. Included with this map unit are miscellaneous land types such as steep broken stony land, smooth stony land and scabland.

The Ritzville and Renslow soils are the major components of Map Unit 1. These have formed in deep loess and are silty throughout. Some soils on the Center have a cemented lime-silica hardpan (Map Unit 2). Most of these soils have developed in thin loess mantling alluvium, old lacustrine deposits or basalt. The cemented hardpan is almost impermeable and difficult to excavate with handtools. Other upland soils are derived from tuffaceous sandstone, shale or conglomerate. A very compact clayey subsoil is a notable feature of these soils.

The Esquatzel and Weirman series comprise the major soils of Map Unit 3. These are alluvial soils that occur in bottomland positions along major drainageways, mainly Selah Creek. Soils are deep, mostly well-drained and commonly stratified with coarse- and fine-grained material in the substratum. These are the most fertile and potentially productive soils on the Center. So-called "riverwash" is included in this map unit. Riverwash consists of recent deposits of loose cobblestones, gravel, sand and some small areas of silt. Locally, some of the fine sand has been moved short distances by wind to adjoining upland positions.

Most soils on the reservation have slight to moderate limitations for engineer or military-related purposes; steep slopes and shallow depths to bedrock are major limiting factors.

For more comprehensive information concerning kinds, distribution and properties of soils on the Yakima Firing Center, the user of this terrain study should seek the assistance of the Soil Conservation Service, U.S. Department of Agriculture, Yakima, Washington.

YAKIMA FIRING CENTER

TABLE D-3, SOIL CHARACTERISTICS AND SELECTED EVALUATIONS

MAP UNIT	MAJOR SOIL SERIES[1]	GEOGRAPHIC SETTING	TYPICAL SOIL PROFILE LAYERS, THICKNESS AND COLOR OF LAYERS[2], DEPTH TO ROCK AND UNIFIED ENGINEERING CLASSIFICATION[3] (PROFILE NOT TO SCALE)		HIGH WATER TABLE DEPTH (METERS) AND DURATION (MONTHS)	PERMEABILITY CENTIMETERS/HOUR OR (INCHES/HOUR)	SHRINK-SWELL POTENTIAL	RATING AND MAJOR KINDS OF LIMITATIONS FOR:[4] SEWAGE LAGOONS	SEPTIC TANK FILTER FIELD	FOUNDATIONS FOR SMALL BUILDINGS	ROAD LOCATION	SHALLOW EXCAVATIONS	TRAFFICABILITY	BIVOUAC SITES	REMARKS
1	Renslow Ritzville	Gently sloping to steep broad upland ridges. Most slopes between 1 and 8 percent. Soils have developed in welldrained silty loess. Natural vegetation mainly bluebunch wheatgrass, sandberg bluegrass and sagebrush.	cm ML 23 ML ML-CL 70 ML 183+	Brown to light brownish gray silt loam; mildly alkaline (pH 7.4). Brown to yellowish brown heavy silt loam; mildly to strongly alkaline (pH 7.6 to 8.6). Light yellowish brown silt loam; strongly alkaline (pH 8.4).	None	1.5 to 5.0 cm/hr (0.6 to 2.0 in/hr)	Low	Moderate (s)	Slight	Moderate (t)	Moderate (t,i)	Slight	Slight when dry; Severe when wet (t)	Slight	Loess is a wind deposited silt which stands well in near-vertical cuts. However, heavy rains or sudden snow melt can cause severe erosion and gullying. When dry, loessial surface soils tend to be powdery, particularly in areas not adequately covered with vegetation.
2	Burke Selah	Nearly level to rolling uplands. Most slopes between 1 and 7 percent. Soils formed in loess mantling alluvium, old lacustrine deposits, or basalt bedrock. Soils well drained. Native vegetation consists primarily of big sagebrush and sparse growth of bunchgrasses.	cm ML 13 ML CL 64 N.C. (not classified) 140 Variable 183+	Pale brown silt loam; mildly alkaline (pH 7.8). Pale brown silt loam; moderately alkaline (pH 8.4). Indurated lime-silica cemented hardpan. More or less cemented gravels and cobblestones, silts and sands, containing angular basalt fragments.	None	1.5 to 5.0 cm/hr (0.6 to 2.0 in/hr) in upper layer Less than 0.5 cm/hr (0.2 in/hr) in cemented hardpan	Low	Moderate (n)	Severe (p)	Moderate (t)	Moderate (t,i)	Severe (n)	Slight when dry; Severe when wet (t)	Slight	
3	Esquatzel Weirman	Level to very gently sloping bottomlands, low terraces and fairly recent alluvial fans. Slopes generally between 0 and 2 percent.	cm ML,SM 18 ML 76 ML or GP 153 Variable 183+	Brown very fine sand loam; neutral (pH 7.0 to 7.2). Pale brown very fine sandy loam (pH 7.4). Light brownish gray sandy loam or gravelly sand. Stratified medium to coarse-textured alluvium derived from loess and basalt.	Rare under natural conditions	2.0 to 6.0 cm/hr (0.8 to 2.5 in/hr)	Low	Moderate (f,s)	Slight	Moderate (t)	Moderate (i,f)	Slight	Slight when dry; Severe when wet (t)	Slight	Brief but intense rains or snow melt may cause local flooding. Map unit area includes "river-wash" gravels and cobblestones along drainageways.
4	Roza	Gently to steeply sloping flanks of ridges and other uplands. Slopes between 2 and 20 percent. Soils derived from material weathered from tuffaceous sandstone, shale or conglomerate bedrock; upper part of soil influenced by loess.	cm CL 23 CL CH 79	Light brownish gray to light gray gravelly clay loam; neutral to mildly alkaline (pH 7.2 to 7.4). Pale brown to brown, very compact silty clay or silty clay loam; mildly alkaline (pH 7.4 to 7.8). Calcareous in lower part. Partly decomposed tuffaceous sedimentary rock.	None	0.5 to 1.5 cm/hr (0.2 to 0.6 in/hr) in upper layer Less than 0.5 cm/hr (0.2 in/hr) in subsoil	Low in upper layer Moderate to high in subsoil	Moderate to Severe (h,r)	Severe (p,h,r)	Moderate (a,h)	Slight to Moderate (i,h)	Moderate (r)	Slight when dry; Severe when wet (t)	Slight	Underlying sedimentary rocks derived principally from light-colored acidic volcanic materials.
5	Rock Creek Starbuck	Shallow, stony soils formed in loess mixed with weathered basalt. Topography gently sloping to very steep along drainageways. Slopes up to 70 percent. Unit includes rough broken land and scabland. Vegetation chiefly sparse bunchgrasses and sagebrush.	cm ML 12 ML GM 35	Dark to light brown silt loam; layer contains few to many basalt rock fragments. Pale brown silt loam, gravelly in many places. Layer contains many basalt rock fragments. Basalt bedrock.	None	1.5 to 5.0 cm/hr (0.6 to 2.0 in/hr)	Low	Severe (r)	Severe (r)	Severe (r)	Severe (r,i)	Severe (r)	Slight to Severe (h)	Slight to Severe (h)	The term "scabland" commonly applies to thin, stony land that is underlain by lava flows of basalt or andesite and that has many rock outcrops.

[1]Soils that have profiles almost alike make up a soil series. The series is the common name of the soil. Each series is named for a town or other geographic feature near the place where a soil of that series was first observed and mapped. Due to the scale of the map, many other minor soils are necessarily included in the map unit.

[2]The diagram depicts the major kinds and sequence and thickness of layers of the typical soil found within the map unit. Obviously, there are many variations to those shown.

[3]The Unified Soil Classification System, Technical Memorandum No. 3-357, U.S. Army Corps of Engineers, March 1953.

[4]DEFINITION OF RATING TERMS

SLIGHT-relatively free of limitations or limitations are easily overcome.
MODERATE-limitations can be overcome with good planning and/or careful design.
SEVERE-limitations are serious and are difficult to overcome.

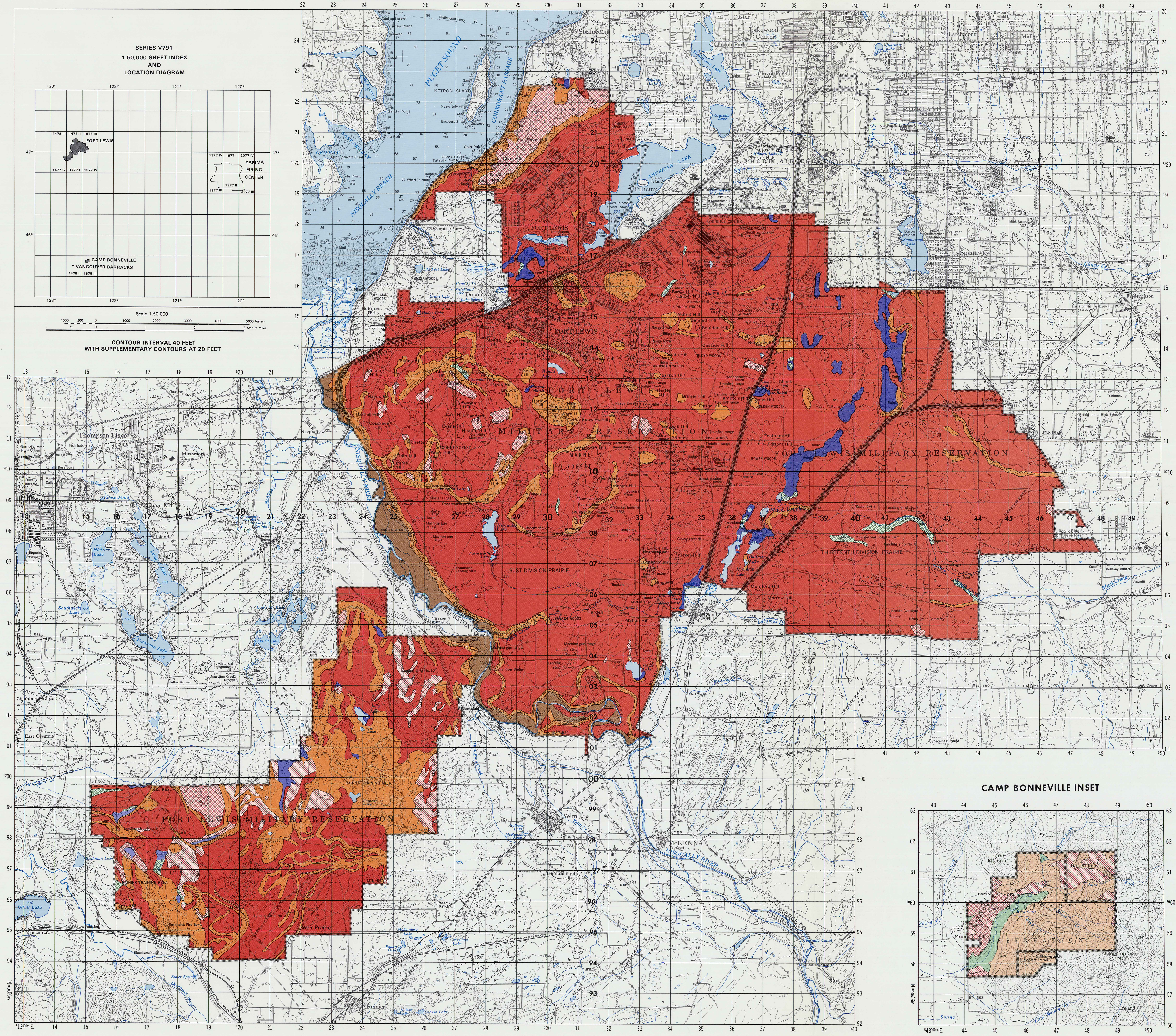
SOIL RELATED PROPERTIES AFFECTING LIMITATIONS

a-high shrink-swell
f-floods
h-slopes
i-frost action
n-hardpan
p-percolates slowly
r-depth to rock or stony
s-porous soil (seepage)
t-low strength

FORT LEWIS, WASHINGTON

(Including Camp Bonneville, Vancouver Barracks and Yakima Firing Center)

TERRAIN ANALYSIS



ENGINEERING SOILS
FORT LEWIS

1 Moderately well to excessively drained sandy and gravelly soils

2 Gravelly soils underlain by cemented, gravelly and/or sandy, unassorted glacial till

3 Moderately well to well drained silty and clayey soils

4 Well drained to excessively drained sandy soils of the alluvial flood plain underlain with stratified layers of sands and gravels

5 Silty and clayey soils of depressions on uplands and terraces; mainly poorly drained

6 Gravelly and sandy soils commonly containing cobbles; most soils excessively drained

7 Peat and other highly organic soils; very poorly drained

Number refers to entry in table.

ENGINEERING SOILS
CAMP BONNEVILLE

1 Very poorly to moderately well drained clayey soils on flood plains and flat, depressed areas.

2 Well drained clayey soils on upland terraces and mountain footslopes

3 Well drained mostly gravelly soils on upland terraces

4 Mostly shallow and stony soils on footslopes of mountains and side slopes of valleys

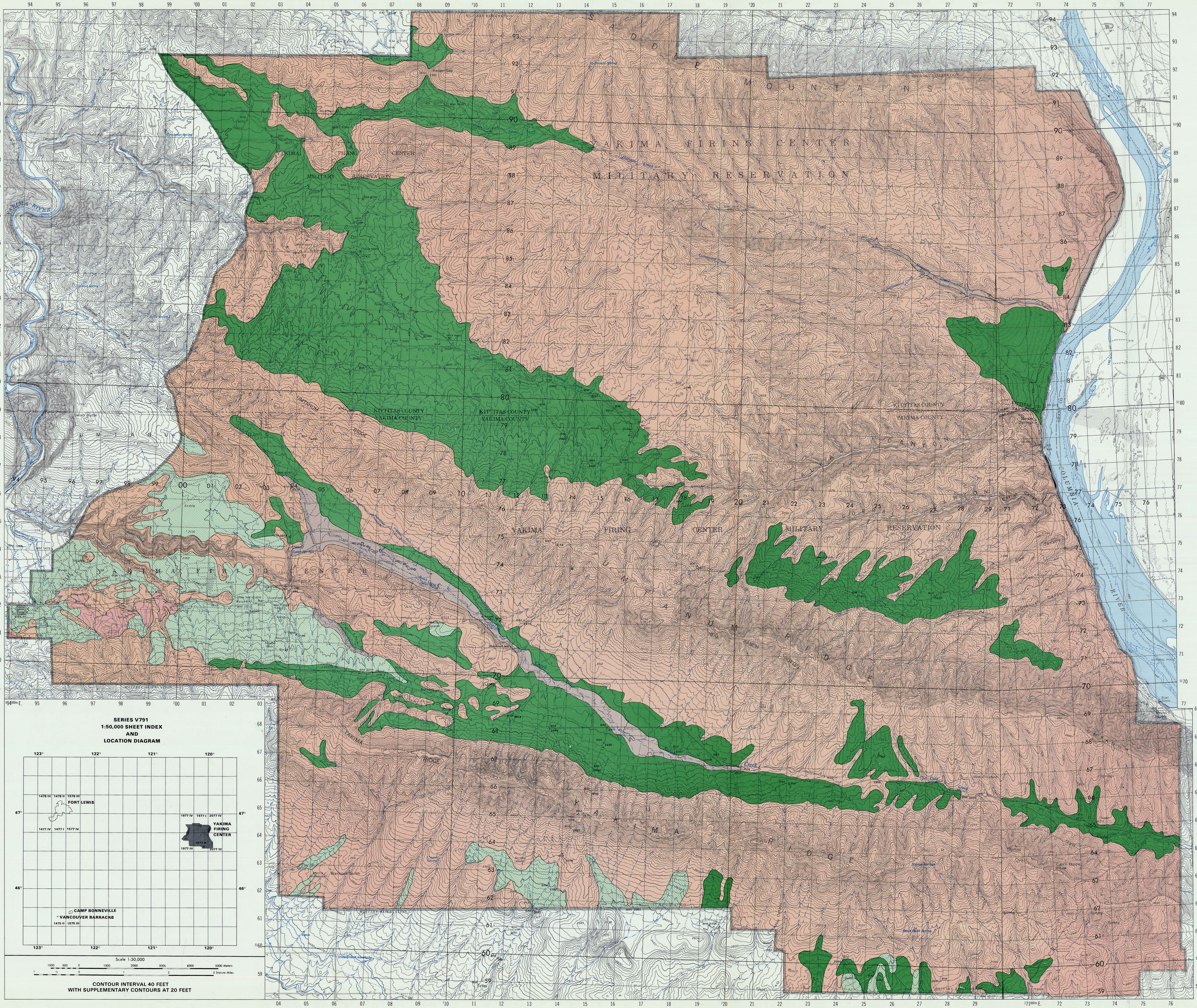
Number refers to entry in table.

Prepared by the Terrain Analysis Center, U. S. Army Engineer Topographic Laboratories, Fort Belvoir, Virginia, March 1977. Cartographic and Reproduction Support by the Defense Mapping Agency Hydrographic/Topographic Center, Washington, D. C. December 1978.

FORT LEWIS, WASHINGTON

(Including Camp Bonneville, Vancouver Barracks and Yakima Firing Center)

TERRAIN ANALYSIS



ENGINEERING SOILS

YAKIMA FIRING CENTER

1. Silty soils developed from deep loess.
2. Mostly silty and clayey soils with a cemented hardpan layer.
3. Loamy to sandy alluvial soils on bottomlands and terraces.
4. Compact loamy to clayey soils mainly over tuffaceous sedimentary rocks.
5. Stony soils mixed with silt; shallow to basalt.

Number refers to entry in table.

Prepared by the Terrain Analysis Center, U. S. Army Engineer Topographic Laboratories, Fort Belvoir, Virginia, March 1977. Cartographic and Reproduction Support by the Defense Mapping Agency Hydrographic/Topographic Center, Washington, D. C. December 1978.

E. ENGINEERING GEOLOGY

FORT LEWIS[1]

Fort Lewis occupies a glacial outwash plain, the geologic material of which consists of layers of unconsolidated gravelly sands, silts, clays, and mixtures of these that have been laid down by a succession of glaciers, usually to depths in excess of 61 meters (200 feet). Typically, the upper portion of this material, laid down during the Vashon glacial epoch 13,500 years ago, consists of three layers, identified from bottom layer to top layer as advance outwash, till and recessional outwash. Advance outwash consists of stratified, medium to coarse sand with gravel or coarse sandy gravel that was laid down by water flowing in front of the advancing glacier. Glacial till is a compact to very compact layer of unsorted clay, silt, sand, and gravel that is essentially impermeable, while recessional outwash is granular material similar to advance outwash that was laid down by water from the receding glacier.

There are no extensive surface exposures of consolidated or otherwise naturally hard rocks reported within Fort Lewis. Surface materials consist mainly of a deep blanket of glacially derived recessional outwash which overlies several sequences of other successively older formations of fine- to very coarse-grained glacial debris. Locally along a few deeply incised streams, there are very narrow and discontinuous exposures of moderately to highly consolidated beds of till and tillite; some of these beds have considerable lateral extent but are mostly buried by many feet of loose glacial debris of variable particle size. The overall thickness of all these materials is several tens to several hundreds of feet.

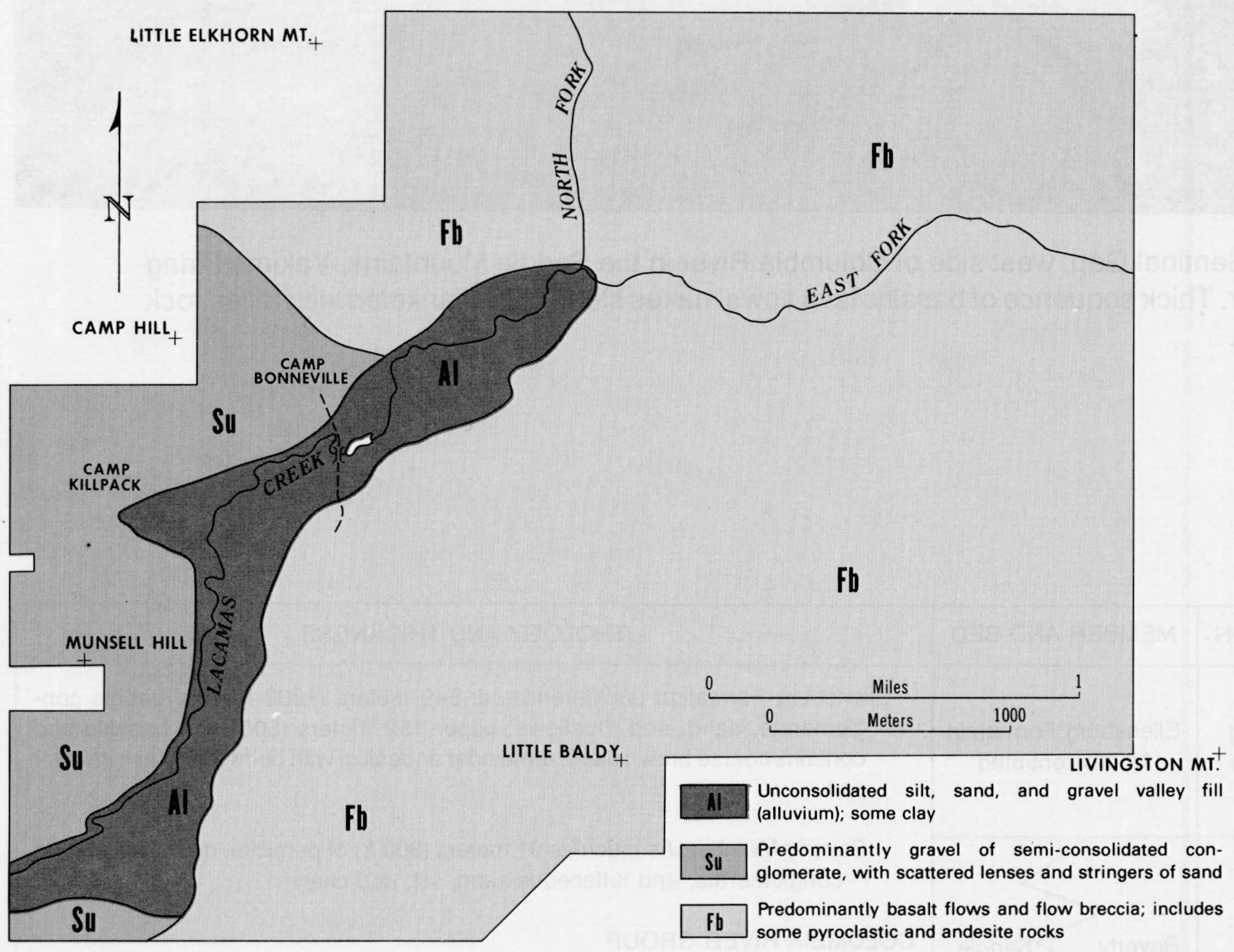
Numerous sand and gravel pits on the reservation are in areas of "Alluvium" (See Engineering Soils Map, Unit 1). A few of the active pits have classification equipment for sizing the materials as excavation proceeds.

Although the Nisqually River is generally difficult of access, it contains tremendous amounts of sand and gravel which are highly suitable for construction aggregate.

Geological and construction evaluations of the outer major soil groups present in the Fort Lewis area are treated in detail in the "Soil Characteristics and Selected Evaluations" table in the soils section of this study.

[1]Data available insufficient for preparation of a map graphic.

CAMP BONNEVILLE



Geologic sketch map of Camp Bonneville Military Reservation, Washington.

Camp Bonneville, with Camp Killpack, covers approximately 1554 hectares (3840 acres) of uplands and hills along the eastern margin of the Willamette-Puget structural trough northeast of the town of Proebstel. About a fourth of the reservation is on generally rolling to hilly terrain and the Lacamas Creek valley of the Troutdale Bench; the remainder is in well dissected hills of the westernmost Cascade Mountains Foothills. Elevations range from 88 meters (289 feet) in Lacamas Creek at the southwest corner of the Camp to 300 meters (1000 feet) at the northwest (Little Elkhorn Mountain), 400 meters (1350 feet) at the northeast, nearly 500 meters (1600 feet) at the southeast (Livingston Mountain), and 440 meters (1452 feet) at the south-central boundary of the Camp (Little Baldy Mountain). Maximum elevations are in the foothills; the only prominences on the Troutdale Bench are Camp Hill 200 meters (656 feet) and Munsell Hill 160 meters (525 feet). The topography is erosional, except for shallow deposition in the Lacamas Creek valley.

Troutdale Bench is the highest of a series of nearly flat plains rising steplike from the level of the Columbia River. It is separated from the lower plains by a scarp 30 to 60 meters (100 to 200 feet) high. This scarp is believed to be largely of structural origin, probably chiefly a downwarping to the west, but in part it may also have been caused by downfaulting to the west.

The sedimentary materials making up the Bench are of the Troutdale Formation (Pliocene age). In Clark County the formation consists of two members—a lower, almost entirely fine-grained one; and, an upper, coarse-grained one which is thickest near the eastern margin of outcrop. Only the upper member is present at Camp Bonneville.

The Upper Troutdale Formation is predominantly a cemented gravel or semiconsolidated conglomerate, with scattered lenses and stringers of sand. At most places the matrix in the gravel consists of medium- to coarse-grained sand derived chiefly from volcanic rocks, with minor amounts of quartz sand. The most distinctive characteristic is the presence of considerable amounts of pebbles and cobbles of metamorphic and igneous rock from bedrock sources apparently outside the drainage area. Cementing materials are iron oxides, clays from alteration during weathering, and, in some places, silica.

Most outcrops of the Troutdale Formation are predominantly gravel (generally weathered), with sand lenses making up 10 to 20 percent of the total. Several miles south of Camp Bonneville, however, a bed of coarse, cemented gritty sandstone covers more than a square mile; and in Lacamas Creek west of the Camp, there occurs a pebbly sandstone, or conglomerate very similar in appearance but with a larger amount of pebbles and cobbles. The large number of erratics in the Troutdale Formation (fragments of quartzite, granite, gneiss, schist, etc. not found in the present drainages) indicates that the formation was deposited by a major stream (presumably the Columbia River or an ancestral Columbia River) flowing from east of the Cascade Range; the Upper Troutdale Formation was deposited in a very broad, shallow valley.

Suitability of the Troutdale Formation for engineering uses is severely restricted because the materials are strongly altered by weathering to depths of as much as 30 meters (100 feet). The uppermost 3 meters (8 to 10 feet) commonly is a silty residual clay with not even pebble outlines remaining; at depths of 4 to 5 meters (12 to 15 feet), pebble outlines are preserved, and at greater depths pebbles can be dug out of the matrix.

The uppermost several meters are unsuited as aggregate or surface course materials, and poorly suited for foundations for heavy structures because the high clay content inhibits drainage and contributes to significant shrink-and-swell effects. Suitabilities of the surface soil materials are considered in the Engineering Soils section of this study.

Underlying the Troutdale Formation in the western Camp Bonneville area [at a depth of about 100 meters (290 feet) at Camp Killpack] is a sequence of volcanic rocks of Upper Eocene age. These rocks make up the Foothills mountainous area of the Camp east of Lacamas Creek valley and Camp Hill; slopes steepen abruptly east of the contact with the Troutdale Formation.

The volcanic rocks are predominantly basalt flows and flow breccia, and include some andesites and pyroclastic deposits. Some interbedded sedimentary rocks probably are present. No detailed description of the rocks is available for the Camp Bonneville area.

The sequence of volcanics was folded and faulted, at least through early Pliocene time, and eroded for a considerable period at the end of Oligocene time. No faults have been identified in the Camp area, largely because weathering, soil formation, and vegetation obscure the bedrock.

Unweathered andesites and basalts are suited for most engineering uses. Dense varieties, however, are tough and difficult to crush; closely spaced joints facilitate crushing. Basalts, particularly, and andesites to a lesser extent, often contain structures (lava tubes, e.g.) and textures (vesicles, e.g.) that diminish the compressive strengths of the rocks (see Engineering Geology of the Yakima Firing Center for a more detailed geologic description of volcanic-rock characteristics).

Construction in or upon and using volcanic materials should be preceded by thorough on-site physical and chemical investigations.

YAKIMA FIRING CENTER

The terrain of Yakima Firing Center is dominated by southeast-northwest trending Manastash, Umtanum, and Yakima Ridges, and Hanson, Squaw, Selah, and Cold Creeks. Hanson Creek drains into the Columbia River; the others drain into the Yakima River. The differences in elevation from major ridge crests to adjacent valley bottoms commonly range from 150 meters to 300 meters (500 feet to 1000 feet) over distances of 2.5 kilometers to 8 kilometers (1.5 miles to 5 miles); the surfaces are generally well dissected. Limited areas of gentle slopes and broad areas of rolling to moderately steep slopes rise toward ridge crests; steepest slopes occur near some crests, along most of the west bank of the Columbia River, in incised lengths of some valleys near the river (e.g., Alkali and Corral Canyons), and in the western several miles of Selah Creek.

Volcanic rock types of two Tertiary formations are the most predominant on Yakima Firing Center. Representing the latest of extensive Tertiary Columbia Plateau lava outpourings, the Yakima Basalt Formation consists mostly of basalt flows with minor interbedded sedimentary units; individual flows seldom are more than 30 meters (100 feet) thick, and all total about 300 meters (1000 feet). Nine flows included in five Member categories and one major sandstone member have been identified on or near the Firing Center, (see sketches of stratigraphic sequences). All the flows have similar compositions, but differ in densities, structures, and textures. The sandstone member, 10+ 3 meters (30+ 10 feet) thick in the Vantage - Priest Rapids area, consists chiefly of quartz-feldspar-mica sand and/or tuffaceous sand of hornblende andesite composition. Most sections include massive or laminated silts or clays, some of which may be bentonitic.

Within the Yakima Basalt Formation (near the middle of the sequence), a bed of diatomite crops out discontinuously in the Squaw Creek drainage basin. The diatomite, part of the Frenchman Springs Basalt Member, was deposited in a lake impounded at the east by the Sentinel Gap Flow of the same member. The bed is about 1.5 meters (5 feet) thick at the Yakima River and thickens eastward in 19 kilometers (12 miles) to about 5.5 meters (17 feet) near the Yakima-Columbia Rivers divide. Diatomite is used for the manufacture of dynamite, pottery glaze, filters, colorizers for liquids, etc.; areas along Squaw Creek shown as "silica mines" on the base map were formerly exploited, but are now inoperative. The deposits are the largest known in the state of Washington.

Representing a later time, when streams from the early Cascades were depositing against the Columbia River, the Ellensburg Formation consists predominantly of volcanic-derived sediments with or without interbedded basalt flows. The total thickness is about 300 to 500 meters (1000 to 1600 feet); in the Sentinel Gap - Priest Rapids area the formation comprises about 130 meters (400 feet) of flows, conglomerates, shales, and other river and lake deposits. Sedimentary materials in the formation include granitic and metamorphic pebbles from northern sources (quartzites, e.g., are from the Northern Rockies), quartz-feldspar-mica sands of the Vantage Sandstone also from the north, volcanic pebbles of Cascade Mountains origin, and various materials derived locally. Sediments, mostly conglomerates and tuffaceous sandstones of the Ellensburg Formation, occur along 17 kilometers (10.5 miles of the northern flank of Yakima Ridge south of Highway 24 and eastward from the western boundary of the Firing Center (see geologic map Hq. Range Central and Selah Creek areas), and at the southwesternmost corner of the Center around Washout Gulch. The formation occurs elsewhere: e.g., the Roza Basalt Member overlies the Squaw Creek diatomite, and the Beverly Member occurs west of the Columbia River between the Kittitas-Yakima Counties border and Priest Rapids. Because the formation is largely streamlaid, thicknesses and shapes of member units vary greatly.

Six kilometers (3.5 miles) up-river from Priest Rapids, the most distinctive lithologic unit of the Beverly Member is exposed—a gray pumicite which has been mined at that site as a source of pozzuolana (a material which imparts certain specific properties to cement). Two beds of the fine-grained, mostly volcanic-glass shard, sediments are interlayered with conglomerate. A very similar material on the east side of Sentinel Gap, 11 kilometers (7 miles) to the north, was mined as a source of pozzuolana for both Wanapum and Priest Rapids Dams.

Most effects and materials associated with Pleistocene glaciation apparently have been obliterated or obscured by sluicing and reworking of deposits by the Columbia River and its tributaries, and by soil formation and agriculture. The generally thin blanket of windblown clayey silts (loess) postulated as having covered much of the western Columbia Plateau, however, was derived from late Pleistocene sources; calcium carbonate nodules (caliche) under some present soils appear to be associated with glacial outwash gravels; and there remain Pleistocene terraces along the Yakima River in Kittitas County and elsewhere.

The basaltic lavas are the principal hard bedrock materials available for engineering use. Flows of the Yakima Basalt Formation (see photo of cliffs near Sentinel Gap) are extensive and commonly continuous over large areas; because they are folded, however, they may be at considerable depths in the fold valleys. Flows in the Ellensburg Formation (see photo of Selah Creek canyon), on the other hand, were deposited concurrently with channeling, ponding, and erosion, and are likely to be discontinuous and more limited in lateral extent; more than one member unit may occur within a large construction site.

In all lava flows, the rock structure may be massive, vesicular, pumiceous, columnar, or flow-banded. Furthermore, flows commonly are interbedded with tuffaceous or other fragmental material blown from a volcanic vent (e.g., pumicite), exploded from intrusion of hot lava into water (e.g., pillow lava), or broken by continued movement of the chilled surface of a flow (e.g., flow breccia). Tunnels and tubes may occur wherever still-fluid lavas flowed out from beneath a hardened surface crust. A zone consisting of rock with many small open spaces (vesicles) generally caps a flow. All these structures and textures contribute to the characteristically high permeability of thin-bedded lavas, and influence rock suitabilities for rip-rap, concrete aggregate, building stone, and road courses.

Unweathered basalt is composed of minute crystals, usually microscopic, associated with small amounts of volcanic glass and occasional distinctly larger crystals (phenocrysts). Primary minerals are silicates of calcium, magnesium, and iron (mostly feldspars and pyroxenes), with minor quartz, olivine, etc. An interlocking texture of small crystallized minerals is conducive to high strength. The glass content imparts hardness and resistance to granulation, but more brittleness as the amount of glass increases.

Basalts are susceptible to decomposition by the warm gases and waters included in the lava before cooling, and by weathering (particularly by circulating ground water). The glasses are unstable chemically, and their decomposition critically decreases the durability and soundness, even though the crushed rock passes tests of soundness. Deposits of highly basaltic sands and gravels near Pasco, Washington, which are satisfactory sources of concrete aggregate, are underlain by deeply weathered sands and gravels of similar composition. Because of the susceptibility of basalt to weathering, the older portions of the deposits have been rendered unsuitable for use; the sands and gravels commonly become coated with opal, which is the silica leached from the basalt pebbles, and the opal coatings are deleteriously reactive with cement alkalies. Although basaltic glasses are not resistant to weathering, they generally do not react unfavorably as aggregate, apparently as a result of low content of silica and high content of calcium and magnesium.

The toughness, strength, durability, favorable surface textures of fragments, and varied joint spacing of basalts (see table of physical constants) make them suitable for many engineering purposes. The variety of structures and textures, however, and susceptibility to chemical alteration demands careful geologic investigations of rock conditions before use.

Other construction materials on the Yakima Firing Center are strongly indurated calcareous-siliceous hardpan layers in old lake deposits, moderately to strongly indurated gravelly cobbly conglomerates, tuffaceous sandstone, weakly to moderately indurated shales, and weakly indurated to loose diatomite. Most of these materials occur in the Ellensburg Formation.

Unconsolidated materials, mostly stony, sandy, and gravelly soils and regolith, are described under the Engineering Soils section of this study. Although only a few borrow pits are depicted on large-scale topographic maps, substantial amounts of sand and gravel have been gotten and processed on the Center for military construction. There also are several shale pits and at least one rock quarry. Enough materials are available, it is reported, that outside purchase sources are unnecessary.

An on-site geologic investigation of an area including Range Central and the Research Station, 8 to 10 kilometers (5-6 miles) east of Post Headquarters, was conducted by the Corps of Engineers, Sacramento District, in connection with drilling an exploratory well near grid coordinates 019725. The stratigraphy at that site illustrates one geologic association from among the many possible local associations implied in the foregoing general regional description.

On the north rim of Selah Creek Canyon (in the vicinity of grid coordinates 035735) the main body of Yakima Basalt is overlain by a layer of Ellensburg sediments which is capped by a basalt layer about 30 meters (100 feet) thick. A flat area which includes the Research Station site is underlain at depths of a few feet by the top of the main Yakima Basalt. A conical hill at coordinates 017724, site of a proposed water tank, consists of Ellensburg sediments capped by basalt. Only boulders of basalt can be seen on the sides and top of the hill, and the thickness of basalt is unknown. South of the paved road, Ellensburg sediments extend east and southeast along the southern side of the valley. The water well at Range Central penetrated about 17 meters (54 feet) of sediments before entering basalt. The sediments probably thicken to the west; the wells at Post Headquarters probably penetrate several hundred feet of sediments before bottoming in basalt.

At the Research Station site, the basalt is overlain by 1 to 2 meters (4 to 6 feet) of fine silt which is slightly cemented and stands in vertical cuts. The unlayered silt probably is windblown sediment (loess). The top of the underlying basalt is heavily coated and impregnated with light gray calcium carbonate (caliche). Variations in the dip of rock layers, only a few degrees from horizontal, indicate that several folds (flexures) trend west-northwest in this area. The axis of an up-fold runs along the north side of Selah Creek canyon (the Selah Butte anticline). A second flexure runs through the Research Station site; on the south side of this up-fold, the sediments in Hill 2192 dip gently southwest. The axis of the major down-fold (syncline) on the north side of Yakima Ridge probably is 0.8 to 1.2 kilometers (0.5 to 0.75 miles) to the southwest. Vertical basalt layers on the south side of the syncline pass through grid coordinates 010705 and 026703. A north-south fault of small displacement is followed by Selah Creek in its bend north of Range Central.

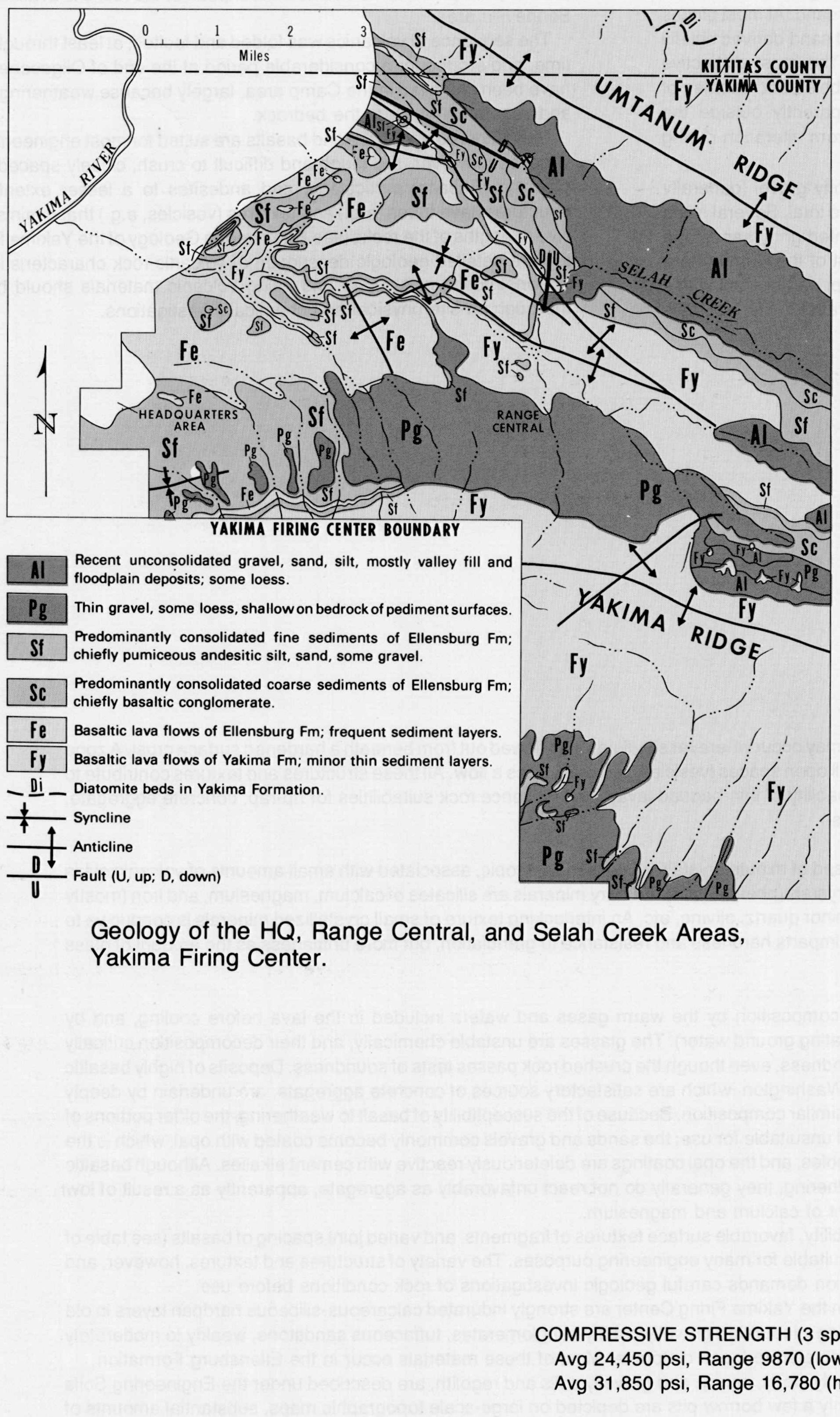
The geologic log of the exploratory well shows an expected alternation of basalt layers, weathered at their tops and commonly grading downward into less altered or unaltered, and layers of decomposed basalts and probable silty or clayey sediments.

E. ENGINEERING GEOLOGY (continued)

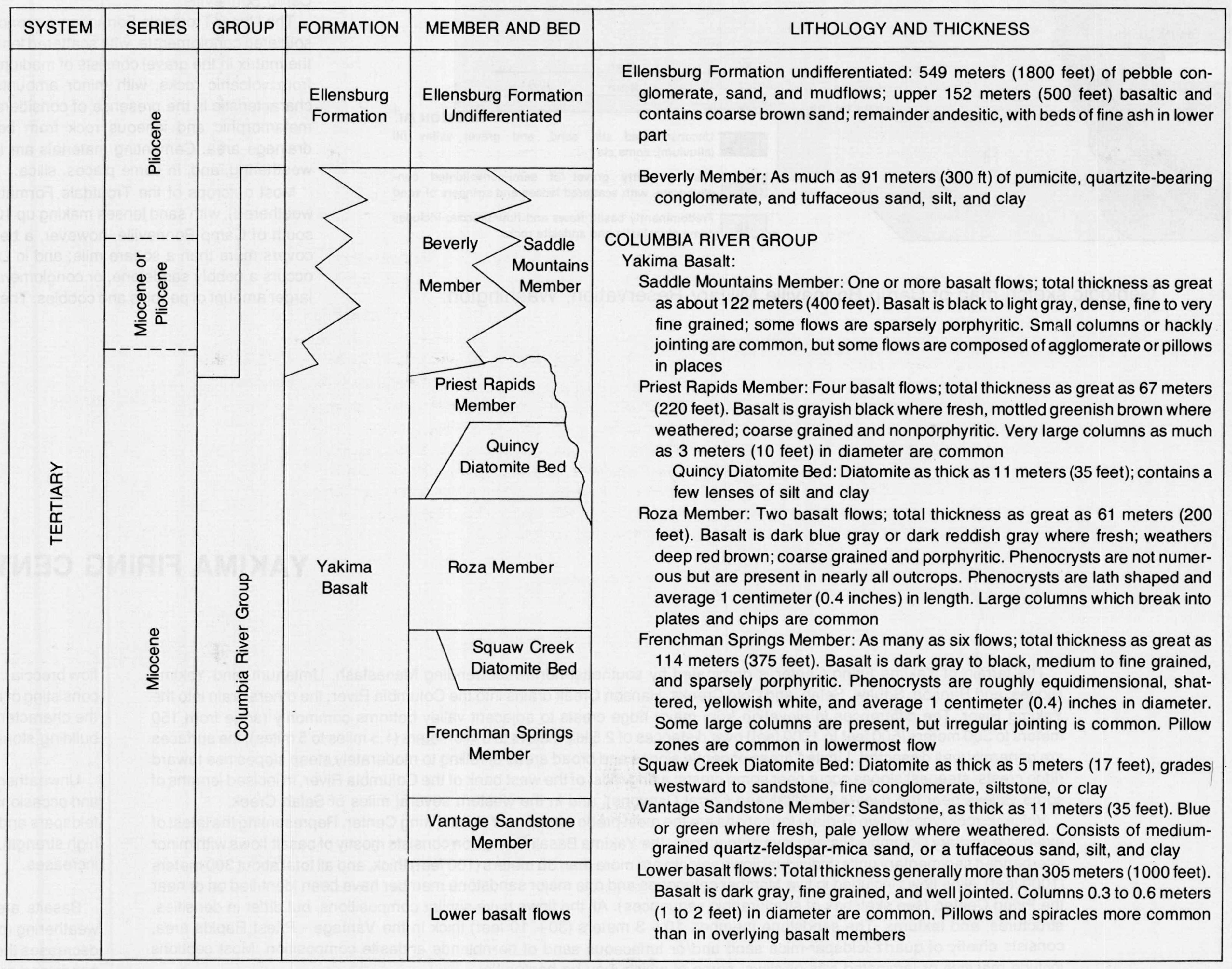
YAKIMA FIRING CENTER

Selah Creek canyon, Yakima Firing Center, looking WSW toward Mt. Adams. Intermittent Selah Creek is deeply incised; flat uplands in foreground are capped by basaltic lava flow.

Near Sentinel Gap, west side of Columbia River in the Saddle Mountains, Yakima Firing Center. Thick sequence of basaltic lava flows makes steep cliffs blanketed with fallen rock (talus).



Geology of the HQ, Range Central, and Selah Creek Areas, Yakima Firing Center.



Composite stratigraphic sequence in the northwestern Columbia Plateau.

COMPRESSIVE STRENGTH (3 spec.)
Avg 24,450 psi, Range 9870 (low str.)
Avg 31,850 psi, Range 16,780 (high str.)

TRIAXIAL STRENGTH, psi
Principal Stress Relationships:
$S_1 = 24{,}570 + 7.4S_3$ (low str.)
$S_1 = 32{,}440 + 6.6S_3$ (high str.)

Equations of Mohr's Envelope:

$$\left.\begin{array}{l} Y = 4{,}500 + 1.2X \\ 2d = \pm\ 450\ @\ Y = 13{,}130 \end{array}\right\}\begin{array}{l}\text{low str.}\\ \text{14 spec.}\end{array}$$

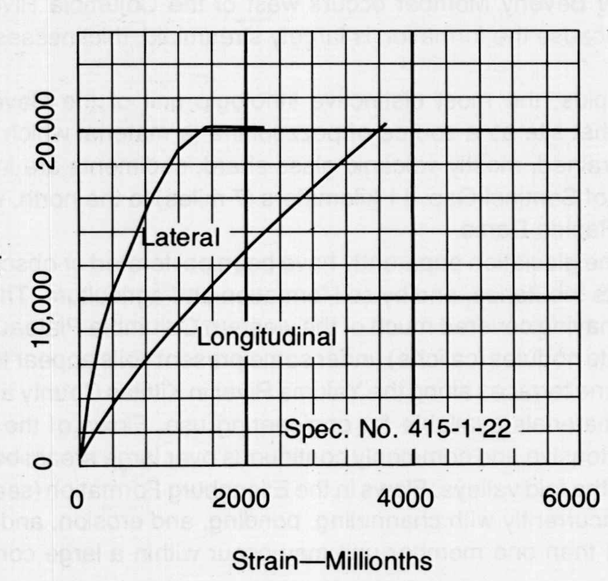
$$\left.\begin{array}{l} Y = 6{,}340 + 1.1X \\ 2d = \pm\ 630\ @\ Y = 16{,}440 \end{array}\right\}\begin{array}{l}\text{high str.}\\ \text{13 spec.}\end{array}$$

STATIC ELASTIC CONSTANTS (6 spec.)

Stress Range psi	Secant E 10^6psi	Range	μ
0–1000	9.1	4.1	0.25
0–2000	9.2	4.4	0.25
0–3000	9.1	4.6	0.24
0–4000	8.9	4.7	0.23
0–5000	8.8	5.0	0.22
0–6000	8.7	5.2	0.22

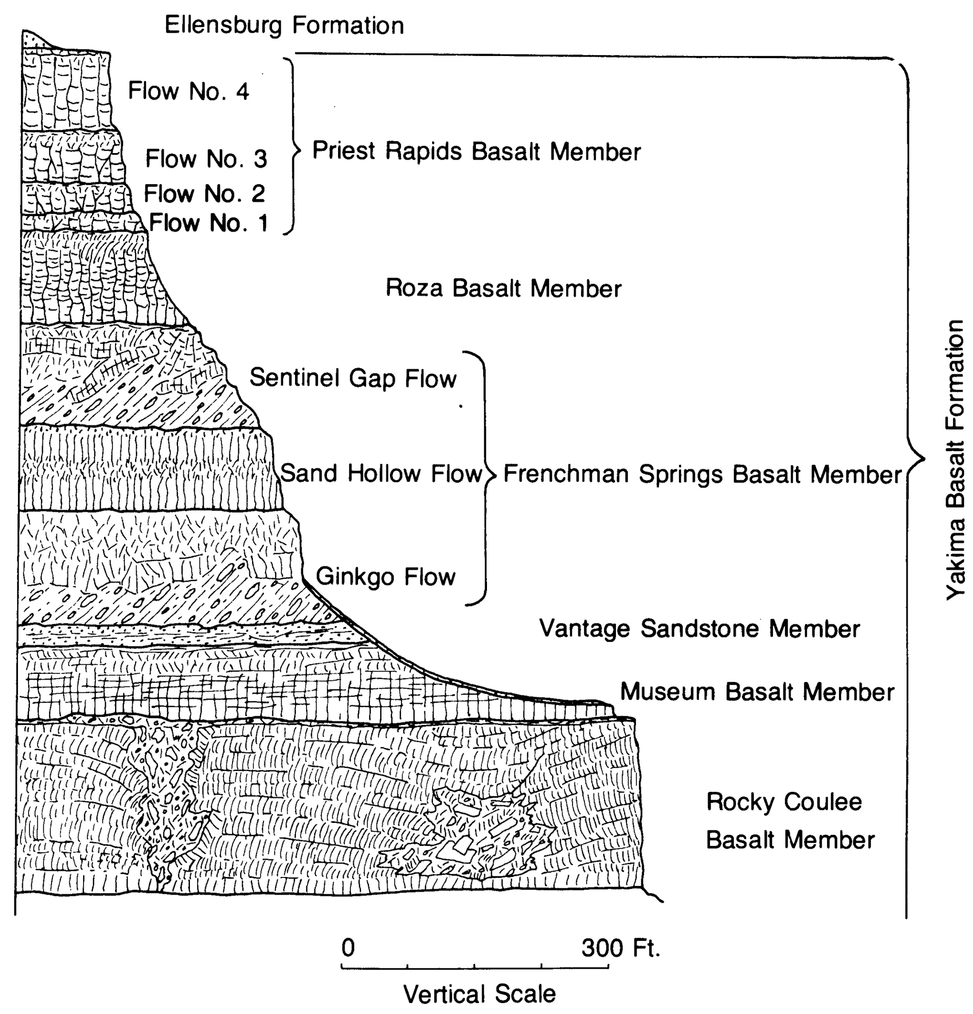
SPECIFIC GRAVITY POROSITY, %

Avg	Range	Avg	Range
(low strength, 14 specimens)			
2.72	0.11	4.50	2.79
(high strength, 13 specimens)			
2.74	0.09	1.63	2.76

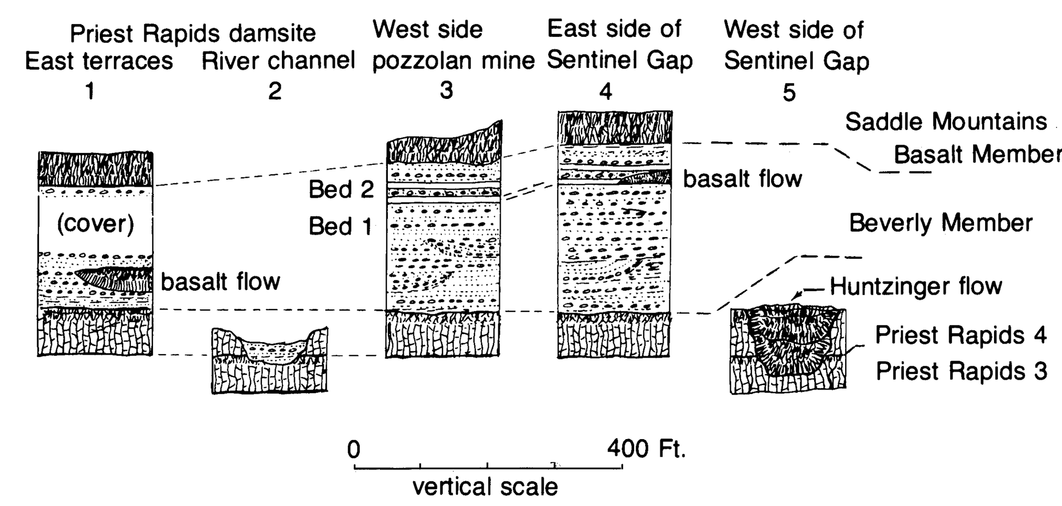


Representative physical constants of basalt (from samples from the Western Cascade Series of Miocene age). Average physical appearance (27 specimens) was dark gray, fine-grained, dense, very hard, with flow structure.

YAKIMA FIRING CENTER



Stratigraphic sequence in the Vantage-Priest Rapids area. The Squaw Creek diatomite (not shown) is the lateral equivalent of the Sentinel Gap flow.



Columnar sections of the lower part of the Ellensburg Formation in the Sentinel Gap-Priest Rapids area.

F. SPECIAL PHYSICAL PHENOMENA

FORT LEWIS

Earthquakes are the only significant special physical phenomena occurring on the reservation. As of mid-August 1972, 157 earthquakes having modified Mercalli intensities of V or greater had occurred in the State of Washington since 1841. The most significant earthquakes had intensities of VII or greater and were 4 in number. Basic data concerning these earthquakes are tabulated below:

Event Date	Intensity	Magnitude (Richter Scale)	Distance from Fort Lewis Barracks
13 Nov 1939	VII	5.8	**35 kilometers (22 miles) WNW**
15 Feb 1946	VII	5.8	**35 kilometers (22 miles) WNW**
13 Apr 1949	VIII	7.1	**9 kilometers (6 miles) W, or 20 kilometers (12 miles) E**
29 Apr 1965	VII+	6.5	**39 kilometers (24 miles) NE**

The 1949 earthquake was not only the strongest to be felt at Fort Lewis, but it was the closest major quake to the Fort. Although the actual location of the epicenter is in doubt, between 9 and 20 kilometers (6 and 12 miles) to the east and west of the Fort Lewis site, an average would put the focus almost directly under Fort Lewis. The very thick blanket of glacial debris, however, tended to dampen the surface effect of the quake. In addition, this heavy blanket of sediments makes it impossible to detect the major faults at depths which are the foci of the quakes, which are felt, or recorded elsewhere, beyond the limits of the sediments.

Probably the most illuminating study concerning earthquakes in the Fort Lewis area is the following:

Naramore Bain Brady & Johanson, Seismic Analysis for Non-Standard Barracks, Fort Lewis, Washington. (Contract No. DACA 05-73-C-0023). 13p., tables, references, maps. Architects, Engineers, Planners, 904 Seventh Ave., Seattle, Washington 98104.

Exhaustive listings and automated mapping of all earthquakes registered in western Washington state during 1973 and 1974 have been published at the University of Washington as part of its Geophysics Program. The reports, by Robert S. Crosson, and Robert S. Crosson and Richard C. Millard, were titled Compilation of Earthquake Hypocenters in Western Washington, for each of the years designated above. Of the 342 quakes registered in 1973 and the 314 in 1974, only one quake for each year occurred beneath Fort Lewis. These were reliably located by resection between 9 regional seismic stations. The Richter magnitudes of these quakes were, respectively, 2.6 and 2.2; depths of foci were 23.8 and 17.9 kilometers (14.8 and 11.1 miles).

CAMP BONNEVILLE

Earthquake monitoring by the University of Washington recorded three tremors with epicenters within one-half degree of longitude or latitude of the Camp in 1973 and 1974—too few to establish a hazard consideration, but enough to indicate that the Cascade Foothills are active, and that movement on unrecognized faults in the Camp area could occur.

A potential for mass movement of unconsolidated surficial material (excessive solifluction, creep, landslides, mudslides) exists anywhere that steep slopes, abundant precipitation, and clayey soils occur. Large-scale denudation of vegetation will permit and accelerate such movement.

Subsurface soundings (seismic refraction measurements) were taken at Camp Bonneville 26 to 30 July 1976 by the Sacramento District, Corps of Engineers, in connection with sewage disposal and water well investigations. The exact alinement along which measurements were made is not available, but it was generally near the north edge of Lacamas Creek valley between Camp Bonneville and Camp Killpack. The following seismic velocities were calculated:

Material	Velocity
Topsoil (loose soil) (location 1)	366 meters per second (1200 feet per second) to depth of 1.1 to 2.7 meters (3.5 to 8.8 feet)
(location 2)	374 meters per second (1226 feet per second) to depth of 1.4 meters (4.6 feet)
(location 3) (sewage lagoon)	358 meters per second (1176 feet per second) to depth of 2.6 meters (8.4 feet)
Sedimentary mat'ls (location 1)	1219 to 1737 meters per second (4000 to 5700 feet per second) to 9 meters (30 feet) penetration depth
(location 2)	1524 meters per second (5000 feet per second)
(location 3) (sewage lagoon)	1355 meters per second (4444 feet per second), hard rock indicated at 18 meters (60 feet)

The velocity of water or water-saturated materials at location 2 was 1524 meters per second (5000 feet per second).

YAKIMA FIRING CENTER

There are no significant special physical phenomena on the Yakima Firing Center that would seriously affect military activities. Earthquakes, known to occur farther eastward in the Rocky Mountains and westward in the Cascades, apparently do not affect this area. Landslides are possible at places where cliffs of flat-lying lava flows are eroded to expose underlying soft sedimentary materials; slides are common at such places farther north up the Columbia River. One geologic source hints at the possibility that uplift of the Cascade Mountains is continuing; if so, there is the possibility of minor movement along present faults on the Firing Center.

G. VEGETATION

FORT LEWIS

Three categories of vegetative cover that are significant in relation to military maneuvers and other training activities are present on the Fort Lewis military reservation. These categories are forests, grasslands and wetlands.

FORESTS:
The forest cover at Fort Lewis is predominantly coniferous, mainly Douglas-fir with associated small stands of western hemlock, western redcedar, ponderosa pine and Pacific yew. The Douglas-fir stands cover approximately two-thirds of the reservation. Stands are even-age with a ninety-year rotation. These stands are formed after the previous stand is either harvested, or destroyed by fire, epidemic or strong winds. Logging of the Douglas-fir make up 88% of all the timber volume cut from the reservation.

The common deciduous species of the Fort Lewis area are red alder, found on moist sites at lower elevations and cottonwood along the stream banks. Deciduous shrubs occur to some extent in all areas and include such species as hazel, sumac, huckleberry, raspberry, blackberry and wild currant. Shrubs increase the hazard of fire and inhibit or prevent forest regeneration.

GRASSLANDS:
Several large prairie grass communities have developed. They are so thick or dense and the competition they provide is so intense as to prevent forestation. Some of the grasses that make up these prairies are ryegrass, fescue, tall oat grass, orchard grass, quack grass and bent grass. Some of the weeds are nettle, tansy ragwort, bracken fern, ox-eye daisy, mullein and Canada thistle. Grazing is permitted in the entire eastern portion of the reservation east of the Burlington Northern Railroad right-of-way but is not utilized at this time.

WETLANDS:
Wetlands occupy a small and fairly insignificant portion of the base. Marshes, containing mostly grasses, are scattered throughout the reservation, usually around natural lakes. Swamps, containing mostly trees, shrubs and brush are mainly in the poorly drained areas southwest of Spanaway Lake.

The location and extent of vegetation by categories and sub-categories are shown on the accompanying vegetation map. Vegetation interpretations were made from 1:12,000-scale black and white aerial photography dated May 1970 and May 1972 and supplemented by smaller scale infrared and black and white aerial photography, various topographic and planimetric maps, textual material and 1976 field notes. Areas on the reservation that have been cleared since May 1970 are not shown on the vegetation map. The vegetation pattern changes frequently due to continued tree harvesting. Open areas, where no vegetation is depicted, are either built-up areas or areas lacking significant vegetation. Descriptive details concerning each map unit are included in Table G-1 below.

TABLE G-1, VEGETATION

MAP UNIT	DESCRIPTION	DISTRIBUTION	REMARKS	COVER	CONCEALMENT
1	Coniferous trees: Largely Douglas-fir along with ponderosa pine, western redcedar, western hemlock and Pacific yew; about 30 to 40 m (98 to 131 ft) average height; trunks usually 45 to 120 cm (18 to 47 in) in diameter; 50 to 100% crown cover density; trunks usually spaced 2 to 5 m (7 to 16 ft) apart; height of lower branches average 3 to 13 m (10 to 43 ft) above the ground; 70% of the trees are between 25 and 55 years of age; 75% or more of each stand composed of coniferous species.	Stands throughout the base; larger areas in the east and southwestern portions of the base; stands cover approximately 50 to 60% of the reservation.	Stands have been influenced by a history of fires; harvesting has been allowed since 1966 with most of the harvesting conducted to the south and east of the cantonment area; reforestation primarily by natural seeding though planting and artificial seeding also employed.	Cover from flat-trajectory fire of small arms for foot troops good in dense stands and fair in more widely spaced stands.	Concealment from aerial and ground observation largely good year-round for foot troops and vehicles.
2	Coniferous trees: Largely Douglas-fir along with ponderosa pine, western redcedar, western hemlock and Pacific yew; trunks generally less than 45 cm (18 in) in diameter; 10 to 50% crown cover density; trees sparsely arranged; branches on young trees to ground level and on scattered mature trees to within 4 m (13 ft) from ground level; sparse undergrowth usually consists of shrub species; 75% or more of each stand composed of coniferous species.	Stands small and widely scattered over the reservation.	Stands have been influenced by a history of fires; harvesting has been allowed since 1966 with most of the harvesting conducted to the south and east of the cantonment area; reforestation primarily by natural seeding though planting and artificial seeding also employed.	Cover from flat-trajectory fire of small arms generally poor for foot troops.	Concealment from aerial observation largely poor year-round for foot troops and vehicles; concealment from ground observation generally fair year-round for foot troops and poor for vehicles.
3	Deciduous trees: Mainly red alder on moist sites, black cottonwood along stream banks, Oregon ash, bigleaf maple and Pacific dogwood; maximum height about 35 m (115 ft); trunks range from 10 to 80 cm (3 to 31 in) in diameter; 50 to 100% crown cover density; trunks generally spaced 1 to 5 m (3 to 16 ft) apart; branches to within 2 m (7 ft) of ground level; moderate to dense undergrowth of brush and shrub usually less than 1 m (3 ft) high; leafless period generally mid-November through mid-May; 75% or more of each stand composed of one or more deciduous species.	Larger stands along the Nisqually River and southwestern portion of the reservation; other smaller stands scattered throughout the base.	These areas have not been influenced by fire due to their close proximity to surface water.	Cover from flat-trajectory fire of small arms for foot troops fair in stands of large size and poor elsewhere.	Concealment from aerial and ground observation largely good from mid-May through mid-November for foot troops and vehicles when trees in leaf and largely poor the rest of the year.
4	Deciduous trees: Mainly red alder on moist sites, black cottonwood along stream banks, Oregon ash, bigleaf maple and Pacific dogwood; height generally less than 15 m (49 ft); trunks range from 10 to 50 cm (3.9 to 20 in) in diameter; 10 to 50% crown cover density; trees moderately spaced; branches to within 1 m (3 ft) of ground level; low shrub species such as hazel, huckleberry, sumac, raspberry, blackberry and wild currant; leafless period generally mid-November through mid-May; 75% or more of each stand composed of one or more deciduous species.	Small size stands widely scattered throughout the reservation.	Shrubs increase fire hazard and inhibit or prevent forest regeneration.	Cover from flat-trajectory fire of small arms largely poor for foot troops.	Concealment from aerial and ground observation largely poor for foot troops and vehicles; some concealment available when in leaf mid-May through mid-November.
5	Mixture of coniferous and deciduous trees: Mainly Douglas-fir, ponderosa pine, western redcedar, western hemlock, Pacific yew, red alder, black cottonwood, Oregon ash, bigleaf maple and Pacific dogwood; about 20 to 35 m (66 to 115 ft) average height; trunks range from 10 to 80 cm (4 to 31 in) in diameter; 50 to 100% crown cover density; trunks generally spaced 1 to 5 m (3 to 16 ft) apart; height of lower branches average 2 to 13 m (7 to 43 ft) above the ground; moderate to dense undergrowth of brush and shrub usually less than 1m (3 ft) high; each stand contains roughly equal distribution of coniferous and deciduous species.	Stands largely scattered throughout except in the eastern portion of the reservation.	Selective cutting employed occasionally; stands not even-aged.	Cover from flat-trajectory fire of small arms for foot troops fair in stands of large size and poor elsewhere.	Concealment from aerial and ground observation largely good from mid-May through mid-November for foot troops and vehicles when trees in leaf, and largely fair the rest of the year.
6	Mixture of coniferous and deciduous trees: Mainly Douglas-fir, ponderosa pine, western redcedar, western hemlock, Pacific yew, red alder, black cottonwood, Oregon ash, bigleaf maple and Pacific dogwood; trunks generally less than 50 cm (20 in) in diameter; 10 to 50% crown cover density; trees moderately spaced; branches from ground level to 4 m (13 ft) from ground level; sparse undergrowth of grass and shrub less than 1 m (3 ft) high; each stand contains roughly equal distribution of coniferous and deciduous species.	Small size stands widely scattered throughout the reservation.	Shrubs increase fire hazard and inhibit or prevent forest regeneration.	Cover from flat-trajectory fire of small arms largely poor for foot troops.	Concealment from aerial and ground observation poor year-round for foot troops and vehicles.
7	Short grasses: Less than 1 m (3 ft) high; common grass species, rye grass, fescue, tall oat grass, orchard grass, quack grass and bent grass; common weed species, nettle, tansy ragwort, bracken fern, ox-eye daisy, mullein and Canada thistle; generally small areas that may include sparsely arranged, scattered trees not to exceed 10% crown cover density.	Grasslands throughout the reservation usually on level or nearly level areas.	Some grasslands used intensively for military purposes; some mowed on a regular basis.	No cover for foot troops.	Concealment from aerial and ground observation poor year-round for foot troops and vehicles.
8	Prairie grasses: Less than 1 m (3 ft) high; common grass species, rye grass, fescue, tall oat grass, orchard grass, quack grass and bent grass; common weed species, nettle, tansy ragwort, bracken fern, ox-eye daisy, mullein and Canada thistle; generally large areas with few or no trees; dense grass; short growth period, spring to mid-summer.	Three major prairies located on, or partially on, Fort Lewis: 91st Division, central; Thirteenth Division, east; Weir, southwest; prairies cover approximately 15 to 20% of the reservation.	Grasses reach such a density as to prevent forestation; Thirteenth Division prairie available for grazing, none utilized; all prairies used for military purposes.	No cover for foot troops.	Concealment from aerial and ground observation poor year-round for foot troops and vehicles.
9	Swamps: Swamps of closely spaced, predominantly deciduous brush, shrubs, and trees with open water areas.	Depression areas south of Spanaway.		Cover from flat-trajectory fire of small arms fair for foot troops; extremely wet soils may preclude use of these areas by foot troops.	Concealment from aerial and ground observation for foot troops and vehicles fair from mid-May through mid-November and poor rest of year; movement of foot troops and vehicles restricted during the wetter seasons of the year.
10	Marsh grasses: Less than 1 m (3 ft) high; in low, generally perennial wet areas; growth open to sparse; most marshes small.	Marshes scattered throughout the reservation except in the eastern portion.		No cover from flat-trajectory fire of small arms.	Concealment from aerial and ground observation poor year-round for foot troops and vehicles.

CAMP BONNEVILLE

There are three categories of vegetative cover on the Camp Bonneville Installation. These are forests, grasslands and wetlands. Of these only two, forests and grasslands have any significance in relation to military maneuvers and training activities.

FORESTS:
The forest cover at Camp Bonneville is primarily coniferous, made up predominantly of Douglas-fir with associated small stands of western hemlock, western redcedar, ponderosa pine and Pacific yew. Most of the Douglas-fir is being rehabilitated and it is either seedling or second growth.

The deciduous forest cover at Camp Bonneville consists of red alder (mostly second growth), black cottonwood, Oregon ash, bigleaf maple and Pacific dogwood. A large portion of the forest cover on Camp Bonneville exists as a mixture of both coniferous and deciduous species.

GRASSLANDS:
Grasslands are maintained on the Camp Bonneville Installation by mowing and raking which serves two purposes; that is, the grasslands can be used for field maneuvers and the maintenance is a fire prevention measure.

The location and extent of vegetation by categories and sub-categories are shown on the accompanying vegetation map. Vegetation interpretations were made from 1:12,000-scale black and white aerial photography dated June 1974 and supplemented by the Camas 1:50,000 topographic map, Camp Bonneville Military Reservation, Clark County, Washington 1:10,560 topographic map and overlay, textual material and 1976 field notes. Areas on the installation that may have been cleared since June 1974 are not shown on the map. Open areas, where no vegetation is depicted, are built-up areas lacking significant vegetation. Descriptive details of each map unit are included in the table G-2 below.

CAMP BONNEVILLE

TABLE G-2, VEGETATION

MAP UNIT	DESCRIPTION	DISTRIBUTION	REMARKS	COVER	CONCEALMENT
1	Coniferous trees: Largely Douglas-fir along with western redcedar, Pacific yew and western hemlock; height ranges between 8 and 35 m (26 and 115 ft); trunks generally 20 to 80 cm (8 to 31 in) in diameter; 50 to 100% crown cover density; trunks usually spaced 1 to 5 m (3 to 16 ft) apart; height of lower branches to within 1 m (3 ft) of ground level; 75% or more of each stand composed of coniferous species.	Stands in a continuous band from southwest to northeast of installation.	Most stands second growth with a mixture of all ages.	Cover from flat-trajectory fire of small arms for foot troops good in older stands and fair in younger.	Concealment from aerial and ground observation good year-round for foot troops and fair for vehicles.
2	Coniferous trees: Largely Douglas-fir along with western redcedar, Pacific yew and western hemlock; height generally up to 3 m (10 ft) mixed with larger firs; trunks generally less than 20 cm (8 in) in diameter; 10 to 50% crown cover density; trees sparsely arranged; branches to ground level; 75% or more of each stand composed of coniferous species.	Large stands scattered over the installation.	Stands are being rehabilitated with Douglas-fir.	Cover from flat-trajectory fire of small arms generally poor for foot troops.	Concealment from aerial and ground observation largely poor year-round for foot troops and vehicles.
3	Deciduous trees: Mainly red alder along with black cottonwood, Oregon ash, bigleaf maple and Pacific dogwood; maximum height about 35 m (115 ft); trunks range from 10 to 80 cm (4 to 31 in) in diameter; 50 to 100% crown cover density; trunks generally spaced 1 to 5 m (3 to 16 ft) apart; branches to within 2 m (7 ft) of ground level; moderate to dense undergrowth of brush and shrub usually less than 1 m (3 ft) high; leafless period generally November through April; 75% or more of each stand composed of one or more deciduous species.	Three stands near center of installation on low moist sites.	All alder is second growth.	Cover from flat-trajectory fire of small arms generally fair for foot troops.	Concealment from aerial and ground observation largely good from May through October for foot troops and vehicles when trees in leaf, and largely poor the rest of the year.
4	Not applicable.				
5	Mixture of coniferous and deciduous trees: Mainly Douglas-fir, ponderosa pine, western redcedar, western hemlock, Pacific yew, red alder, black cottonwood, Oregon ash, bigleaf maple and Pacific dogwood; about 20 to 35 m (66 to 115 ft) average height; trunks range from 10 to 80 cm (4 to 31 in) in diameter; 50 to 100% crown cover density; trunks generally spaced 1 to 5 m (3 to 16 ft) apart; height of lower branches range 2 to 13 m (7 to 43 ft) above the ground; moderate to dense undergrowth of brush and shrub usually less than 1 m (3 ft) high, each stand contains roughly equal distribution of coniferous and deciduous species.	Stands in the center of installation parallel to creeks.	Dense stands along creek banks.	Cover from flat-trajectory fire of small arms for foot troops fair in stands of large size and poor elsewhere.	Concealment from aerial and ground observation largely good from May through October for foot troops and vehicles when trees in leaf, and largely fair the rest of the year.
6	Mixture of coniferous and deciduous trees: Mainly Douglas-fir, ponderosa pine, western redcedar, western hemlock, Pacific yew, red alder, black cottonwood, Oregon ash, bigleaf maple and Pacific dogwood; trunks generally less than 50 cm (20 in) in diameter; 10 to 50% crown cover density; trees moderately spaced; branches from ground level to 4 m (13 ft) from ground level; undergrowth of grass and shrub; each stand contains roughly equal distribution of coniferous and deciduous species.	Stands located in southeastern portion of installation.	Shrubs, due to lack of ground cover.	Cover from flat-trajectory fire of small arms largely poor for foot troops.	Concealment from aerial and ground observation poor year-round for foot troops and vehicles.
7	Short grasses: Less than 1 m (3 ft) high; common grass species, rye grass, fescue, tall oak grass, orchard grass, quack grass and bent grass; common weed species, nettle, tansy ragwort, bracken fern, ox-eye daisy, mullein and Canada thistle; areas may include sparsely arranged, scattered trees not to exceed 10% crown cover density.	Short grass areas are located generally in the Lacamas Creek bottom.	Grassy areas are kept mowed and raked for fire prevention.	No cover for foot troops.	Concealment from aerial and ground observation poor year-round for foot troops and vehicles.
8	Not applicable.				
9	Not applicable				
10	Marsh grasses: Less than 1 m (3 ft) high; in low, generally perennial wet area; growth open to sparse.	One located on North Fork Lacamas Creek.		No cover from flat-trajectory fire of small arms.	Concealment from aerial and ground observation poor year-round for foot troops and vehicles.

YAKIMA FIRING CENTER

The vegetative cover of Yakima Firing Center is typical eastern Washington semi-arid and arid rangeland and is characterized as a sagebrush-bunchgrass type. Grasses and shrubs make up the primary vegetative cover with some scattered trees found in the stream bottoms and within the cantonment area.

Blue bunch wheat grass, Idaho fescue and Sandberg bluegrass were the dominant native grasses but are disappearing due to fire, cultivation and overgrazing. Cheat, which is highly flammable, has become the dominant grass in this area. Along with cheat are needle grass, poa secunda, June grass, yarrow and tarweed. These make up the ground grass cover. Most grasses are less than 1 meter (3 feet) high.

The principal shrub cover of Yakima is big sagebrush, low sagebrush, rabbit brush and wild rose. Shrubs can attain a height of 2 meters (7 feet). Shrubs have been planted in some areas primarily for food and cover for wildlife. Some shrubs such as hawthorn, service berry and mock orange occur along stream bottoms with some tree species.

Tree cover on this installation is of little significance for military purposes. Some of the stream bottoms support a narrow band of trees such as willow, black cottonwood and Russian olive. Remnants of family orchards can still be found on Yakima and some trees have been planted and maintained in the cantonment area for landscaping purposes.

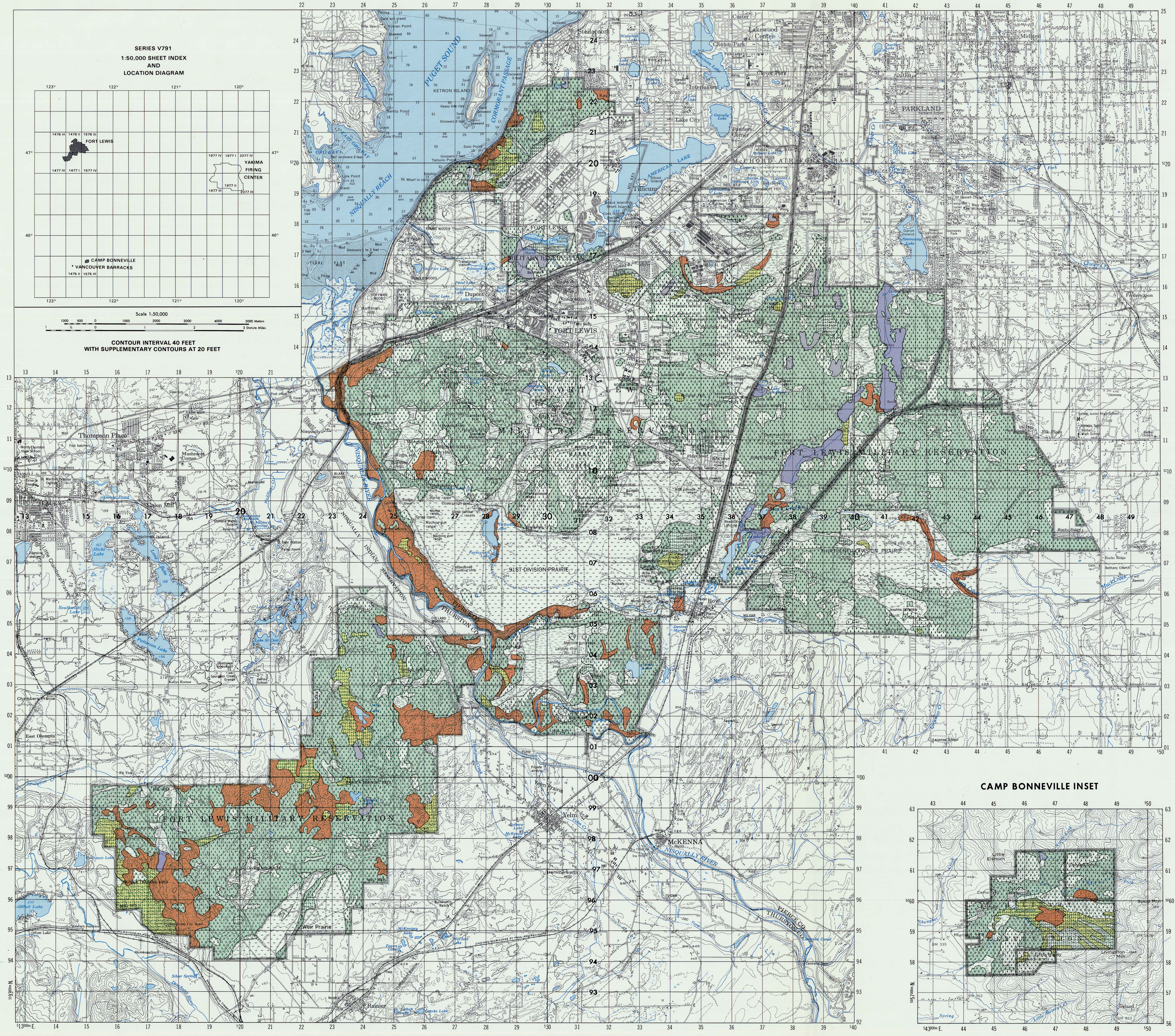
During the dry season, which is usually between July and September, almost all plants are dormant.

There are some areas on Yakima on which no vegetation grows and some areas on which the vegetation has been burned off. Fire frequently opens many areas allowing the vegetative cover to change.

As of October 1976 prescribed grazing is permitted for cattle and sheep on six leased units totaling approximately 80,940 hectares (200,000 acres). Prescribed grazing will help the native vegetation in several ways. It will assist in fire suppression, in planting through trampling action, and allow alternate pastures to rest for one year periods.

The vegetative cover on Yakima affords no concealment from aerial or ground observation for foot troops or vehicles. The vegetation does not provide any cover from flat-trajectory fire of small arms for foot troops.

No map prepared



FORT LEWIS, WASHINGTON

(Including Camp Bonneville, Vancouver Barracks and Yakima Firing Center)

TERRAIN ANALYSIS

VEGETATION

FORT LEWIS-CAMP BONNEVILLE

FORESTS

1 Coniferous trees; medium to dense spacing

2 Coniferous trees; nearly open to medium spacing

3 Deciduous trees; medium to dense spacing

4 Deciduous trees; nearly open to medium spacing

5 Mixed coniferous and deciduous trees; medium to dense spacing

6 Mixed coniferous and deciduous trees; nearly open to medium spacing

GRASSLANDS

7 Short grasses

8 Prairie grasses

WETLANDS

9 Swamps; wet areas with over 50% in trees

10 Marshes; wet areas with over 50% in grasses

OTHER

OPEN Built-up areas; barren areas, and heavily used areas. Vegetation not a significant factor.

Number refers to entry in table.

COVER AND CONCEALMENT

MAP UNIT	VEHICLE CONCEALMENT FROM AERIAL OBSERVATION	VEHICLE CONCEALMENT FROM GROUND OBSERVATION	FOOT TROOP CONCEALMENT FROM AERIAL OBSERVATION	FOOT TROOP CONCEALMENT FROM GROUND OBSERVATION	FOOT TROOP COVER
1	Good	Good	Good	Good	Good-Fair*
2	Poor	Poor	Poor	Fair	Poor
3	Good-Poor**	Good-Poor**	Good-Poor**	Good-Poor**	Fair-Poor***
4	Poor	Poor	Poor	Poor	Poor
5	Good-Fair**	Good-Fair**	Good-Fair**	Good-Fair**	Fair-Poor***
6	Poor	Poor	Poor	Poor	Poor
7	Poor	Poor	Poor	Poor	Poor
8	Poor	Poor	Poor	Poor	Poor
9	Fair-Poor**	Fair-Poor**	Fair-Poor**	Fair-Poor**	Fair
10	Poor	Poor	Poor	Poor	Poor

*Depending on density of stand
**Depending on seasonal leaf coverage
***Depending on size of stand

Prepared by the Terrain Analysis Center, U. S. Army Engineer Topographic Laboratories, Fort Belvoir, Virginia, March 1977. Cartographic and Reproduction Support by the Defense Mapping Agency Hydrographic/Topographic Center, Washington, D. C. December 1978.

H. CLIMATE

FORT LEWIS

The climate of Fort Lewis is characterized by warm, generally dry summers and mild, wet winters. Weather and climate are strongly affected by the imposing north-south barrier of the Cascade Mountains situated some 64 kilometers (40 miles) to the east of the installation and, to a lesser extent, by the short, steep Olympic Mountains about 80 kilometers (50 miles) to the northwest.

January is the coldest month of the year with a mean daily minimum temperature at exactly freezing level, 0.0°C or 32°F. December is almost as cold as January. The warmest month at Fort Lewis is July, closely followed by August. However, the mean daily maximum temperature in July is only 23.9°C or 75°F. Over a 26-year period of record, the highest temperature measured at McChord AFB was 37.8°C or 100°F, while the lowest was −21.1°C or −6°F. Both these extreme records were set in recent years and were not exceeded during the much longer period of record (nearly 100 years) at the nearby meteorological stations of Seattle and Olympia.

In the Fort Lewis area, the average frost-free season ranges from late April to early October, with variation based on elevation and distance from Puget Sound. Fall rains begin in October as the Aleutian Low Pressure system replaces the Pacific High as the dominating synoptic feature. Southerly to southwesterly winds prevail through most of the year and in the winter months there is continual cloudiness with a majority of days showing at least a trace of precipitation. Winter night temperatures are generally in the thirties (°F), and reach about 7.2° to 10.0°C (45° to 50°F) during the day.

Hazardous flying weather, in the form of snow and icing conditions, severely curtails flight operations in the Fort Lewis vicinity, especially eastbound flights over the Cascades. Once or twice each winter, on average, large anti-cyclones of dry Polar air intrude over the area producing much colder but clear nights and days and northerly winds. When these cold periods of about 7 to 10 days are breaking up, typically, snowfall changing to rain occurs. The average annual snowfall is only 238.8 millimeters (9.4 inches). Every two or three years, however, snow falls in amounts sufficient to hinder highway travel. A maximum of 203.2 millimeters (8 inches) has been recorded at McChord AFB and 533.4 millimeters (21 inches) at the Seattle-Tacoma Airport, which is 35.4 kilometers (22 miles) NNE. Some winters pass with no snow.

During the spring months the track of the Pacific storms moves gradually northwards, the effects of maritime disturbances lessen and the Puget Sound Lowlands are under the influence of the Pacific High. The Pacific High air mass is mostly modified maritime polar air which produces mild and pleasant weather conditions. Clearing skies at night are usually followed by fog or low stratus clouds in the early morning which normally dissipate by noon. Daily maximum temperatures are between 21.1° and 26.7°C (70° and 80°F) in the summer and on those occasions when they rise to 32.2°C (90°F) or above, the humidity is usually correspondingly lowered, so that uncomfortable heat is rare.

In the area of environmental health the military makes use of composite temperature stress indices "wind chill" in the measurement of cold and Wet Bulb Globe Temperature or WBGT in the case of heat stress. When a cold air temperature is combined with a high wind speed, the result, so far as its impact on the human body is concerned, is equivalent to a much lower temperature without wind movement. Wind chill temperatures at Fort Lewis are also far from as extreme as those found in mid-continental North American or in Alaskan sites, but since they may occasionally drop to perhaps −34.4°C (−30°F) they present some threat of frostbite to exposed personnel. During summer WBGT readings seldom climb above the levels at which Army Regulations (see TB Med 175) recommend discontinuance of strenuous training by unacclimatized personnel.

The total annual precipitation at Fort Lewis is about 1,043 millimeters (41 inches), but only about one-sixth of this total falls within the 5 months of May through September. Annual variations show a range between 610 millimeters (24 inches) in 1952 and 1,397 millimeters (55 inches) in 1950. The highest monthly precipitation on record was 328.2 millimeters (12.92 inches) in January 1953. Nearly every year has a summer dry period lasting from two to four weeks during which there is no rain, low humidity and extreme fire danger to forests.

Mean wind speed varies little throughout the year, holding at 6.4 to 8.0 kmph (4 to 5 mph); the prevailing direction is southerly from September to February, gradually moving to westerly by July. The Coast Range tends to protect the area from the hurricane-force winds accompanying some of the fall and winter Pacific storms along the coast less than 97 kilometers (60 miles) away, moderating the wind to about 80 kmph (50 mph) gusts. Basic climate and ephemerical information for Fort Lewis is provided in the following tables.

TABLE H-1, TEMPERATURE, PRECIPITATION, HUMIDITY, WIND AND VISIBILITY[1]

PARAMETER DESCRIPTION	UNIT OF MEASURE	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC	ANNUAL	YEARS OF RECORD
Temperature															
Absolute Maximum Temperature	°C	16.10	20.00	23.30	28.30	32.80	37.20	37.80	36.70	35.60	27.80	22.20	16.70	37.80	26
	°F	61.00	68.00	74.00	83.00	91.00	99.00	100.00	98.00	96.00	82.00	72.00	62.00	100.00	26
Mean Daily Maximum Temperature	°C	6.70	9.40	11.10	14.40	18.30	20.60	23.90	23.30	21.10	15.60	10.60	7.80	15.00	26
	°F	44.00	49.00	52.00	58.00	65.00	69.00	75.00	74.00	70.00	60.00	51.00	46.00	59.00	26
Mean Daily Minimum Temperature	°C	0.00	1.10	1.70	3.90	6.70	9.40	11.10	11.10	8.90	6.10	2.80	1.10	5.60	26
	°F	32.00	34.00	35.00	39.00	44.00	49.00	52.00	52.00	48.00	43.00	37.00	34.00	42.00	26
Absolute Minimum Temperature	°C	−21.10	−18.30	−11.10	−2.80	−2.80	1.70	3.90	5.00	−0.60	−4.40	−16.70	−13.90	−21.10	26
	°F	−6.00	−1.00	12.00	27.00	27.00	35.00	39.00	41.00	31.00	24.00	2.00	7.00	−6.00	26
Mean Number Days with Maximum Temperature Equal to or Greater than 90°F (32.2°C)	days	0.00	0.00	0.00	0.00	0.10	0.30	1.40	0.80	0.20	0.00	0.00	0.00	2.30	26
Mean Number Days with Minimum Temperature Equal to or less than 32°F (0.0°C)	days	15.00	11.00	11.00	4.00	0.20	0.00	0.00	0.00	0.10	2.30	9.40	11.50	64.50	26
Normal Heating Degree Days (Base 65°F, 18.3°C)	degree days	831.00	636.00	648.00	489.00	313.00	167.00	80.00	82.00	170.00	397.00	612.00	760.00	5185.00	30
Normal Cooling Degree Days (Base 65°F, 18.3°C)	degree days	0.00	0.00	0.00	0.00	5.00	14.00	65.00	45.00	16.00	0.00	0.00	0.00	145.00	30
Mean Dew Point Temperature	°C	1.10	2.20	2.20	3.90	6.70	9.40	11.10	11.10	10.00	7.80	4.40	2.80	6.10	27
	°F	34.00	36.00	36.00	39.00	44.00	49.00	52.00	52.00	50.00	46.00	40.00	37.00	43.00	27
Precipitation															
Mean Monthly Precipitation	mm	170.90	120.40	103.90	67.10	45.00	37.30	18.80	26.40	40.10	109.00	156.00	148.30	1043.20	12
	in	6.73	4.74	4.09	2.64	1.77	1.47	0.74	1.04	1.58	4.29	6.14	5.84	41.07	12
Mean Number Days with Precipitation Equal to or Greater than 0.1 inch (2.54 millimeters)	days	14.20	11.20	11.90	7.70	5.30	5.00	2.00	2.90	4.80	9.50	12.50	13.60	100.60	12
Absolute Maximum Monthly Precipitation	mm	328.20	231.40	213.40	104.60	120.90	99.10	53.30	116.60	141.50	227.30	246.10	241.30	328.20	31
	in	12.92	9.11	8.40	4.12	4.76	3.90	2.10	4.59	5.57	8.95	9.69	9.50	12.92	31
Absolute Minimum Monthly Precipitation	mm	21.80	42.20	14.50	8.40	8.90	3.30	T[2]	9.30	T	18.30	28.20	95.30	T	31
	in	0.86	1.66	0.57	0.33	0.35	0.13	T	0.01	T	0.72	1.11	3.75	T	31
Absolute Maximum 24-hour Precipitation	mm	43.20	71.10	55.90	45.70	25.40	30.50	30.50	22.90	38.10	38.10	76.20	61.00	76.20	26
	in	1.70	2.80	2.20	1.80	1.00	1.20	1.20	0.90	1.50	1.50	3.00	2.40	3.00	26
Mean Number Days with Thunderstorms	days	0.10	0.10	0.20	0.80	0.70	1.00	0.50	1.00	0.40	0.40	0.20	0.20	5.60	12
Mean Monthly Snowfall	mm	111.80	48.30	35.60	0.00	0.00	0.00	0.00	0.00	0.00	0.00	27.90	15.20	238.80	26
	in	4.40	1.90	1.40	0.00	0.00	0.00	0.00	0.00	0.00	0.00	1.10	0.60	9.40	26
Mean Number Days with Snowfall Equal to or Greater than 1.5 inch (38.1 millimeters)	days	1.20	0.30	0.40	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.20	0.20	2.30	12
Humidity															
Mean Percent Relative Humidity	%	87.00	84.00	80.00	75.00	72.00	72.00	69.00	72.00	78.00	85.00	87.00	89.00	79.00	12
Wind															
Percent Frequency of Surface Wind Speed Greater than 27 knots (31.1 mph or 50.0 kmph)	%	0.10	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.10	0.00	0.00	12
Percent Frequency of Surface Wind Speed Greater than 16 knots (18.4 mph or 29.6 kmph)	%	2.70	1.90	2.90	1.60	1.00	0.30	0.20	0.00	0.60	1.10	2.00	1.70	1.30	12
Mean Number Days with Surface Wind Equal to or Greater than 16 knots (18.4 mph or 29.6 kmph) and no Precipitation															
at 1600 LST	days	1.00	1.00	1.20	1.30	0.90	0.30	0.40	0.10	0.60	0.70	0.20	0.40	8.10	12
at 2200 LST	days	0.80	0.70	0.40	0.20	0.10	0.00	0.00	0.00	0.10	0.10	0.70	0.40	3.50	12
at 0400 LST	days	0.70	0.40	0.30	0.10	0.00	0.00	0.00	0.00	0.00	0.00	0.20	0.50	2.20	12
at 1000 LST	days	0.60	0.10	1.20	0.40	0.40	0.10	0.10	0.00	0.30	0.30	0.50	0.50	4.50	12
Mean Number Days with Surface Wind 4 to 10 knots (4.6 to 11.5 mph or 7.4 to 18.5 kmph) and Temperature 33° to 89°F (0.6° to 31.7°C) and no Precipitation at 1600 LST	days	11.00	13.40	16.60	18.50	19.40	20.80	23.00	24.10	19.70	17.70	12.50	12.40	209.10	12
at 2200 LST	days	8.40	9.10	10.40	10.80	12.10	13.90	12.30	11.00	7.90	7.50	7.40	9.10	110.90	12
at 0400 LST	days	8.10	8.70	9.00	8.30	8.20	8.60	7.40	6.90	6.00	7.60	6.90	9.60	95.30	12
at 1000 LST	days	8.70	11.30	13.40	15.60	18.70	18.20	19.80	19.10	16.50	12.80	9.00	10.40	173.50	12
Fastest One Minute Wind Speed	knots	39.08	31.26	35.60	33.00	27.79	25.18	20.84	21.71	25.18	26.05	29.53	36.47	39.08	8
	kmph	72.42	57.93	65.98	61.15	51.50	46.67	38.62	40.23	46.67	48.28	54.72	67.59	72.42	8
	mph	45.00	36.00	41.00	38.00	32.00	29.00	24.00	25.00	29.00	30.00	34.00	42.00	45.00	8
Visibility															
Mean Number Days with an Occurrence of Visibility Less than 0.5 mile (0.8 kilometer)	days	7.60	4.90	3.70	1.30	0.90	0.80	1.90	2.90	6.80	10.00	8.60	8.40	57.80	12
Percent Frequency Ceiling Less than 5,000 feet (1,524 meters) or Visibility Less than 5 miles (8.05 kilometers)	%	68.40	66.10	58.40	47.40	41.30	46.10	32.80	29.80	46.10	61.50	62.00	8.60	53.20	12

H. CLIMATE (continued)

FORT LEWIS

TABLE H-1, TEMPERATURE, PRECIPITATION, HUMIDITY, WIND AND VISIBILITY[1] (continued)

PARAMETER DESCRIPTION	UNIT OF MEASURE	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC	ANNUAL	YEARS OF RECORD
Percent Frequency Ceiling Less than 1,500 feet (457.2 meters) or Visibility Less than 3 miles (4.83 kilometers)															
for 0000 to 0200 LST	%	24.90	21.10	13.80	7.40	5.90	8.00	7.20	9.20	19.20	35.30	31.20	27.30	17.50	12
for 0300 to 0500 LST	%	23.20	22.90	18.80	11.50	11.70	17.60	21.60	24.20	31.10	38.70	31.30	28.50	23.40	12
for 0600 to 0800 LST	%	24.60	25.00	20.00	14.40	12.20	19.50	27.30	31.70	38.70	41.60	31.20	28.30	26.20	12
for 0900 to 1100 LST	%	25.70	21.90	16.80	8.40	7.70	11.80	12.50	14.60	22.70	30.70	29.40	27.90	19.20	12
for 1200 to 1400 LST	%	21.60	17.80	9.60	1.80	3.90	4.00	1.50	3.20	8.20	16.20	21.10	24.60	11.10	12
for 1500 to 1700 LST	%	22.00	16.20	6.90	1.90	2.20	3.00	0.80	1.70	5.00	14.10	22.80	25.50	10.20	12
for 1800 to 2000 LST	%	24.80	16.70	8.30	2.40	2.10	2.50	1.40	3.00	8.50	17.20	25.50	27.50	11.70	12
for 2100 to 2300 LST	%	27.20	19.60	10.20	3.40	2.80	4.70	3.00	3.10	11.20	24.70	30.90	28.30	14.10	12
Percent Frequency Ceiling Less than 300 feet (91.4 meters) or Visibility Less than 1 mile (1.61 kilometers)															
for 0000 to 0200 LST	%	9.70	6.50	3.60	1.30	1.00	0.50	0.00	0.70	6.10	15.10	13.20	13.30	5.90	12
for 0300 to 0500 LST	%	9.20	8.60	4.70	2.50	2.60	2.80	3.00	5.90	14.90	21.10	14.30	13.70	8.60	12
for 0600 to 0800 LST	%	9.30	10.40	8.60	3.10	1.90	1.80	5.60	7.30	18.10	25.40	16.40	14.60	10.20	12
for 0900 to 1100 LST	%	8.40	5.30	3.90	0.30	0.10	0.30	0.00	0.40	4.90	12.00	11.90	13.50	5.10	12
for 1200 to 1400 LST	%	5.60	1.60	1.00	0.10	0.00	0.00	0.00	0.20	0.50	1.70	4.80	7.80	1.90	12
for 1500 to 1700 LST	%	5.60	2.50	0.70	0.00	0.00	0.10	0.00	0.10	0.40	1.30	5.10	8.30	2.00	12
for 1800 to 2000 LST	%	8.90	4.00	0.40	0.10	0.20	0.00	0.30	0.00	1.00	3.60	8.60	12.10	3.30	12
for 2100 to 2300 LST	%	11.60	5.60	1.80	0.10	0.40	0.00	0.10	0.60	2.60	9.30	12.50	13.40	4.80	12
Mean Number Days with Sky Cover Less than 30% and Visibility Greater than 3 miles (4.83 km)															
at 1600 LST[3]	days	2.20	2.00	2.10	3.30	4.30	5.60	15.40	11.50	10.90	5.00	3.00	1.50	66.80	12
at 2200 LST	days	3.90	3.70	4.70	9.20	8.90	9.30	18.10	15.70	13.40	6.50	4.70	2.00	100.10	12
at 0400 LST	days	3.70	3.00	5.10	7.10	6.10	3.90	9.10	10.00	8.30	3.70	4.60	3.10	67.70	12
at 1000 LST	days	2.10	1.70	2.00	3.20	3.20	4.00	10.20	8.50	6.40	2.00	2.10	1.10	46.50	12
Mean Number Days with Ceiling Greater than 1,000 ft (304.8 m) and Visibility Greater than 3 miles (4.83 km)															
at 1600 LST	days	25.60	24.80	29.50	29.60	30.70	29.50	30.90	30.70	28.60	27.40	24.20	23.60	335.10	12
at 2200 LST	days	23.00	23.30	28.60	29.50	30.70	29.30	30.40	30.20	27.00	24.40	21.30	23.20	320.90	12
at 0400 LST	days	24.40	22.10	26.20	27.80	28.10	25.80	25.70	25.40	21.80	19.20	21.00	23.00	290.50	12
at 1000 LST	days	23.30	23.00	27.10	28.80	29.50	28.70	29.20	29.40	24.70	22.00	22.10	23.00	310.80	12
Mean Number Days with Ceiling Greater than 2,000 ft (609.6 m) and Visibility Greater than 3 miles (4.83 km) and Surface Wind Less than 10 knots (11.5 mph or 18.5 kmph)															
at 1600 LST	days	16.90	15.70	15.90	18.70	19.70	21.00	23.00	23.80	19.30	20.40	18.20	17.10	229.70	12
at 2200 LST	days	16.20	17.40	22.00	25.80	27.20	25.80	29.30	28.70	25.20	21.10	15.90	17.20	271.80	12
at 0400 LST	days	18.20	17.40	19.80	23.80	24.80	22.40	22.50	22.10	19.40	16.20	16.50	16.90	240.00	12
at 1000 LST	days	16.20	15.80	15.50	17.60	19.20	19.50	21.80	20.20	18.20	16.10	16.40	16.40	212.90	12
Mean Number Days with Ceiling Greater than 2,500 ft (762.0 m) and Visibility Greater than 3 miles (4.83 km)															
at 1600 LST	days	20.20	20.90	25.70	27.60	28.40	27.50	30.00	29.30	27.00	24.60	21.20	19.90	302.30	12
at 2200 LST	days	19.80	20.10	25.60	26.60	28.50	26.90	29.10	28.50	25.50	22.10	18.00	19.90	290.60	12
at 0400 LST	days	20.20	18.60	22.40	24.00	25.10	21.80	21.90	21.00	19.10	17.30	18.50	18.90	248.80	12
at 1000 LST	days	18.80	18.40	20.60	22.10	23.70	19.70	21.60	20.60	20.70	19.80	19.40	19.00	244.40	12
Mean Number Days with Ceiling Greater than 6,000 ft (1,828.8 m) and Visibility Greater than 3 miles (4.83 km)															
at 1600 LST	days	10.10	11.10	13.10	15.80	17.40	16.70	24.40	22.20	21.20	17.10	13.30	10.90	193.30	12
at 2200 LST	days	9.20	10.80	14.80	19.30	20.60	19.50	24.60	23.60	22.00	14.30	11.40	9.30	199.40	12
at 0400 LST	days	10.50	8.60	11.20	14.70	16.70	12.80	16.60	15.80	14.50	9.10	10.70	8.20	149.40	12
at 1000 LST	days	8.90	9.20	11.00	12.40	13.30	10.50	16.60	15.60	14.40	11.20	11.60	9.30	144.00	12
Mean Number Days with Ceiling Greater than 10,000 ft (3,048.0 m) and Visibility Greater than 3 miles (4.83 km)															
at 1600 LST	days	7.80	8.40	10.80	13.80	15.10	13.90	22.90	19.90	19.70	14.10	10.90	8.20	165.50	12
at 2200 LST	days	7.60	8.50	12.20	16.80	18.40	17.30	23.60	21.90	19.10	12.10	8.90	7.00	173.40	12
at 0400 LST	days	7.80	7.30	8.60	12.80	14.60	11.10	15.30	14.40	12.60	7.60	8.00	6.30	126.40	12
at 1000 LST	days	6.80	7.50	8.20	10.90	11.70	9.20	16.10	14.30	13.30	9.10	10.00	7.70	124.80	12

TABLE H-2, EPHEMERIS (PACIFIC STANDARD TIME)[4]

	NAUTICAL TWILIGHT					NAUTICAL TWILIGHT					NAUTICAL TWILIGHT					NAUTICAL TWILIGHT			
DATE	BEGINNING	END	SUNRISE	SUNSET	DATE	BEGINNING	END	SUNRISE	SUNSET	DATE	BEGINNING	END	SUNRISE	SUNSET	DATE	BEGINNING	END	SUNRISE	SUNSET
Jan 1	0642	1745	0757	1631	Apr 1	0442	1947	0549	1839	Jul 1	0244	2143	0418	2009	Oct 1	0502	1856	0608	1750
Jan 11	0641	1755	0754	1642	Apr 11	0420	2003	0530	1853	Jul 11	0254	2135	0425	2005	Oct 11	0516	1836	0622	1730
Jan 21	0636	1807	0748	1656	Apr 21	0359	2020	0511	1907	Jul 21	0309	2123	0435	1956	Oct 21	0530	1819	0636	1712
Feb 1	0626	1821	0736	1712	May 1	0338	2037	0454	1921	Aug 1	0327	2104	0448	1943	Nov 1	0545	1802	0653	1654
Feb 11	0614	1835	0722	1728	May 11	0319	2055	0440	1934	Aug 11	0344	2045	0501	1928	Nov 11	0558	1749	0708	1640
Feb 21	0558	1850	0705	1743	May 21	0302	2112	0427	1946	Aug 21	0401	2024	0514	1911	Nov 21	0611	1741	0722	1629
Mar 1	0545	1901	0650	1755	Jun 1	0248	2129	0418	1958	Sep 1	0419	2000	0529	1850	Dec 1	0622	1735	0735	1622
Mar 11	0526	1915	0631	1810	Jun 11	0240	2139	0414	2005	Sep 11	0434	1938	0542	1830	Dec 11	0632	1734	0746	1620
Mar 21	0505	1930	0611	1824	Jun 21	0239	2144	0414	2009	Sep 21	0448	1916	0555	1810	Dec 21	0639	1737	0753	1623

[1]Climate information (with exception of four parameters) is derived from data collected by the weather station on McChord AFB, Ft. Lewis, located Latitude 47°09'N, Longitude 122°29'W, Elevation 101.2 meters (332 feet). Information for four parameters (Normal Heating Degree Days, Normal Cooling Degree Days, Absolute Maximum Monthly Precipitation, and Absolute Minimum Monthly Precipitation) is derived from data collected by the weather station at Seattle-Tacoma International Airport, located Latitude 47°08'N, Longitude 122°28'W, Elevation 98.1 meters (322 feet), about 35.4 kilometers (22 miles) NNE of the McChord AFB weather station. Precipitation and temperature characteristics of the two stations are very similar.

[2]T = Trace

[3]LST = Local Standard Time

[4]Ephemeris provided by Nautical Almanac Office, U.S. Naval Observatory for Latitude 47°09' N, Longitude 122°29' W.

CAMP BONNEVILLE

Camp Bonneville is ten miles due north of the Troutdale, Oregon airport which has the nearest weather station and is the source location for data presented here. Although climate conditions throughout Camp Bonneville are largely similar, there are minor differences due to slightly higher elevations, 106.68 m (350 ft) at the Camp Bonneville billeting areas versus 8.84 m (29 ft) at Troutdale. Within the military reservation local differences of over 304.8 m (1000 ft) in elevation cause some variations on weather and climate conditions.

Camp Bonneville, roughly 120.7 kilometers (75 miles) from the Pacific Ocean and near the base of the western slope of the Cascade Mountains, is an area with a temperate marine climate. Coastal mountains serve to moderate intense winter storms approaching from the Pacific Ocean and the Cascade Range modifies severe storms approaching from the east. However, Camp Bonneville is near the "open funnel" end of the Columbia River Gorge and in the winter, cold easterly winds coming through the gorge occasionally cause a "silver thaw", or glaze of ice, formed by rain falling through the lower-level cold air moving westward.

Temperatures below freezing occur on 50.7 days of the year. The frost free season generally extends from 17 April to 28 October. The mean daily minimum temperature for the month of January, the coldest month, is −1.39°C (29.5°F). The lowest temperature, −16.11°C (3°F), has been recorded in both January and February. Mean maximum temperatures for December, January and February range from 4.72°C (40.5°F) to 9°C (48.2°F).

The warmest months are June, July, August and September, when mean daily maximum temperatures range between 22.22°C (72°F) and 26.67°C (80°F). The highest temperature recorded, 39.44°C (103°F), was in August of 1952. The hottest weather usually occurs when dry easterly winds reach the reservation.

Precipitation is heaviest in winter, when prevailing southwesterly winds carry warm moist air to the area. Mean monthly precipitation ranges between about 13.4 cm (5.26 in) and about 17.9 cm (7.03 in) between October and March; in these months, 79% of the annual precipitation occurs. During the rainy season, precipitation is generally moderate and continuous for periods of several hours or more. However, some thunderstorms do occur on 1 or 2 days each month from May through October. July and August are the driest months with mean monthly precipitation less than 2.54 cm (1 in).

Snowfall is greatest in January when the mean monthly amount is 24.6 cm (9.7 in); about 6 to 8 cm (2 to 3 in) of snowfall occurs in February and March and less than 1.5 cm (0.6 in) during November and December. The greatest monthly snowfall, 93.22 cm (36.7 in), occurred in January of 1950. The amount of snowfall and the accumulation on the ground increases rapidly with increases in elevation.

Winds out of the east are the coldest and strongest, and occur about 25 percent of the time. These cold winter winds occasionally freeze rain from overriding rain clouds coming from the southwest and thus can create a severe and damaging ice storm. Other winds usually blow from the west. Winds are strongest in the winter and one southwest gust was measured at 135.18 kmph (84 mph) on 4 December 1945.

Visibility is best during July, August and September, with one-third of the days being clear and another one-third cloudy; the few remaining days are partly cloudy. October through March is the cloudiest period and on a monthly average, 23 days are cloudy, 3 clear and the remaining 4 or 5 days partly cloudy.

Wind chill under mean temperatures and wind speeds present little danger. There is no great danger even under the recorded extremes in temperature and wind speed. Basic climatic and ephemerical information for Camp Bonneville is provided in the following tables.

TABLE H-3, TEMPERATURE, PRECIPITATION, HUMIDITY, WIND AND VISIBILITY[1]

PARAMETER DESCRIPTION	UNIT OF MEASURE	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC	ANNUAL	YEARS OF RECORD
Temperature															
Absolute Maximum Temperature	°C	15.00	18.89	26.67	29.44	32.78	35.56	37.78	39.44	35.00	3.11	19.44	18.89	39.44	7
	°F	59.00	66.00	80.00	85.00	91.00	96.00	100.00	103.00	95.00	88.00	67.00	66.00	103.00	7
Mean Daily Maximum Temperature	°C	4.72	9.00	11.67	16.83	20.67	22.72	26.33	26.50	24.50	16.89	11.00	7.56	16.61	7
	°F	40.50	48.20	53.00	62.30	69.20	72.90	79.40	79.70	76.10	62.40	51.80	45.60	61.80	7
Mean Daily Minimum Temperature	°C	−1.39	1.17	3.00	4.61	7.44	10.11	11.61	11.56	9.33	6.67	3.89	2.22	5.83	7
	°F	29.50	34.20	37.40	40.30	45.40	50.20	52.90	52.80	48.80	44.00	39.00	36.00	42.50	7
Absolute Minimum Temperature	°C	−16.11	−16.11	−4.44	−1.67	−0.56	2.78	5.56	5.00	1.67	−4.44	−3.89	−6.11	−16.11	7
	°F	3.00	3.00	24.00	29.00	31.00	37.00	42.00	41.00	35.00	24.00	25.00	21.00	3.00	7
Mean Number Days with Maximum Temperatures Equal to or Greater than 90°F (32.2°C)	days	0.00	0.00	0.00	0.00	0.00	2.00	3.40	4.60	4.20	0.00	0.00	0.00	14.20	6
Mean Number Days with Minimum Temperatures Equal to or Less than 32°F (0.0°C)	days	16.50	10.90	6.30	2.00	0.20	0.00	0.00	0.00	0.00	2.60	4.60	7.60	50.70	5
Normal Heating Degree Days (Base 65°F, 18.3°C)[2]	degree days	834.00	622.00	598.00	432.00	264.00	128.00	48.00	56.00	119.00	347.00	591.00	753.00	4792.00	34
Normal Cooling Degree Days (Base 65°F, 18.3°C)[2]	degree days	0.00	0.00	0.00	0.00	7.00	38.00	114.00	106.00	35.00	0.00	0.00	0.00	300.00	34
Mean Dew Point Temperature	°C	−2.78	1.11	2.78	4.44	7.78	11.11	12.22	12.78	10.56	7.22	5.00	2.22	6.11	5
	°F	27.00	34.00	37.00	40.00	46.00	52.00	54.00	55.00	51.00	45.00	41.00	36.00	43.17	
Precipitation															
Mean Monthly Precipitation	mm	159.51	151.38	133.60	55.63	55.12	55.63	22.35	12.45	49.78	146.05	178.56	168.91	1188.97	7
	in	6.28	5.96	5.26	2.19	2.17	2.19	0.88	0.49	1.96	5.75	7.03	6.65	46.81	7
Absolute Maximum Monthly Precipitation	mm	255.27	285.75	172.72	102.36	108.97	122.43	36.83	38.86	90.93	258.83	267.46	254.00	285.75	7
	in	10.05	11.25	6.80	4.03	4.29	4.82	1.45	1.53	3.58	10.19	10.53	10.00	11.25	7
Absolute Minimum Monthly Precipitation	mm	33.02	70.61	93.98	34.29	25.40	3.05	0.76	3.56	9.65	18.54	25.91	130.56	0.76	7
	in	1.30	2.78	3.70	1.35	1.00	0.12	0.03	0.14	0.38	0.73	1.02	5.14	0.03	7
Mean Number Days with Precipitation Equal to or Greater than 0.1 in (2.54 mm)	days	14.8	13.3	12.8	7.70	6.40	4.20	2.40	2.20	4.20	9.40	13.20	16.40	107.00	6
Mean Number Days with Thunderstorms	days	0.00	0.50	0.20	0.70	1.00	2.00	0.70	0.30	1.70	1.30	0.60	0.00	9.00	6
Mean Monthly Snowfall	mm	228.60	81.28	63.50	0.00	0.00	0.00	0.00	0.00	0.00	0.00	T	15.24	388.62	5
	in	9.00	3.20	2.50	0.00	0.00	0.00	0.00	0.00	0.00	0.00	T	0.60	15.30	5
Mean Snow Depth	mm	246.38	83.82	71.12	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	15.24	416.56	6
	in	9.70	3.30	2.80	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.60	16.40	6
Maximum Snow Depth	mm	932.18	365.76	383.54	T[3]	T	T	0.00	0.00	0.00	T	33.02	33.02	932.18	7
	in	36.70	14.40	15.10	T	T	T	0.00	0.00	0.00	T	1.30	1.30	36.70	7
Mean Number Days with Snowfall Equal to or greater than 1.5 in (38.1 mm)	days	2.10	0.30	0.50	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	2.90	6
Humidity															
Mean Percent Relative Humidity	%	79.00	81.00	77.00	70.00	71.00	72.00	70.00	72.00	74.00	82.00	83.00	83.00	76.00	5
Wind															
Percent Frequency of Surface Wind Speed Equal to or Greater than 28 knots (32.24 mph or 51.9 kmph)	%	1.20	2.10	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	1.00	0.30	5
Percent Frequency of Surface Wind Speed Equal to or Greater than 17 knots (19.58 mph or 31.5 kmph)	%	28.10	17.70	7.70	3.10	0.60	0.10	0.00	0.00	1.10	5.90	15.70	21.00	8.50	5
Fastest One Minute Wind Speed[2]	knots	46.89	52.97	45.50	52.10	36.47	34.74	26.92	25.18	52.97	76.42	48.63	49.50	51.90	26
	kmph	86.90	98.17	91.73	96.56	67.59	64.37	49.89	46.67	98.17	141.62	90.12	91.73	96.18	26
	mph	54.00	61.00	57.00	60.00	42.00	40.00	31.00	29.00	61.00	88.00	56.00	57.00	88.00	26
Mean Number Days with Surface Wind Equal to or Greater than 17 knots (19.58 mph or 31.5 kmph) and no Precipitation[4]															
at 1600 LST	days	8.20	4.10	2.20	1.80	0.40	0.00	0.20	0.00	0.20	1.30	4.70	7.00	30.20	6
at 2200 LST	days	7.50	3.20	0.90	0.20	0.00	0.00	0.00	0.00	0.30	0.80	4.80	5.40	23.00	6
at 0400 LST	days	6.90	2.10	0.90	0.20	0.00	0.00	0.00	0.00	0.00	1.60	5.10	5.90	22.70	6
at 1000 LST	days	9.00	4.00	2.40	1.50	0.40	0.00	0.40	0.00	1.40	2.30	6.20	8.00	34.60	6
Mean Number Days with Surface Wind 4 to 10 knots (4.61 to 11.52 mph or 7.4 to 18.5 kmph) and Temperature 33° to 89°F (0.6° to 31.7°C) and no Precipitation															
at 1600 LST	days	6.40	13.60	16.00	20.60	21.80	21.40	22.70	19.80	17.40	15.50	11.10	11.00	197.30	6
at 2200 LST	days	6.90	9.90	12.60	15.80	18.70	17.60	18.50	20.30	12.10	9.20	8.70	9.00	159.30	6
at 0400 LST	days	6.70	7.10	9.60	9.30	10.90	8.90	7.30	5.30	8.10	8.10	8.00	9.50	98.80	6
at 1000 LST	days	6.30	11.80	14.40	14.30	19.70	19.00	16.60	17.40	13.10	12.70	9.20	7.80	162.30	6
Visibility															
Mean Number Days with an Occurrence of Visibility Equal to or Less than 0.5 mile (0.8 km)	days	5.70	2.20	1.50	0.50	0.20	0.00	0.00	1.00	3.70	6.70	5.30	1.30	28.10	5
Percent Frequency Ceiling Equal to or Less than 5,000 ft (1,524 m) or Visibility Equal to or Less than 5 miles (8.05 km)	%	51.40	49.20	45.10	33.90	32.30	34.00	25.60	26.40	29.70	49.70	46.20	52.60	39.70	5

CAMP BONNEVILLE

TABLE H-3, TEMPERATURE, PRECIPITATION, HUMIDITY, WIND AND VISIBILITY[1] (continued)

PARAMETER DESCRIPTION	UNIT OF MEASURE	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC	ANNUAL	YEARS OF RECORD
Percent Frequency Ceiling Equal to or Less than 1,500 ft (457.2 m) or Visibility Equal to or Less than 3 miles (4.828 km)															
for 0000 to 0200 LST	%	16.30	10.40	8.40	3.30	1.40	5.20	0.70	5.00	4.40	15.60	16.50	13.00	8.40	6
for 0300 to 0500 LST	%	16.10	11.00	9.70	4.20	4.10	11.10	5.40	11.50	17.40	20.70	20.30	16.70	12.40	6
for 0600 to 0800 LST	%	17.20	11.00	14.30	5.10	7.20	11.80	12.20	17.10	31.00	29.30	22.40	13.30	16.00	6
for 0900 to 1100 LST	%	14.50	10.20	12.00	2.70	2.40	6.70	4.30	3.00	14.70	18.90	17.80	7.50	9.60	6
for 1200 to 1400 LST	%	12.30	9.10	5.90	0.60	0.60	1.10	0.60	0.60	6.70	11.30	11.30	7.00	5.60	5
for 1500 to 1700 LST	%	12.80	10.90	4.00	0.60	1.10	0.00	0.00	0.00	5.20	10.40	8.40	7.80	5.10	5
for 1800 to 2000 LST	%	17.20	9.10	6.00	1.50	1.90	0.70	0.00	0.00	4.10	11.90	11.90	7.30	6.00	6
for 2100 to 2300 LST	%	16.10	7.10	5.80	1.10	1.80	1.90	0.70	0.70	3.30	10.80	15.60	9.50	6.20	6
Percent Frequency Ceiling Equal to or Less than 300 ft (91.4 m) or Visibility Equal to or Less than 1 mile (1.609 km)															
for 0000 to 0200 LST	%	5.90	1.60	0.40	0.30	0.00	0.70	0.00	0.00	2.20	7.00	7.80	1.40	2.30	6
for 0300 to 0500 LST	%	7.30	1.00	0.90	0.70	0.00	1.90	0.00	1.40	5.20	12.60	7.80	1.60	3.40	6
for 0600 to 0800 LST	%	6.30	2.90	4.70	0.40	1.40	0.30	0.00	2.00	6.40	16.40	11.00	1.50	4.40	6
for 0900 to 1100 LST	%	3.80	0.60	2.20	0.00	0.00	0.00	0.00	0.00	0.40	6.20	4.40	0.20	1.50	6
for 1200 to 1400 LST	%	4.00	1.50	0.80	0.00	0.00	0.00	0.00	0.20	0.70	0.80	0.00	0.00	0.70	5
for 1500 to 1700 LST	%	1.30	2.10	0.00	0.00	0.00	0.00	0.00	0.00	0.00	1.10	0.40	1.10	0.50	5
for 1800 to 2000 LST	%	3.20	2.00	0.90	0.00	0.00	0.00	0.00	0.00	0.00	2.60	2.00	1.90	1.00	6
for 2100 to 2300 LST	%	4.10	1.20	0.00	0.00	0.00	0.00	0.00	0.00	0.70	4.00	5.60	0.20	1.30	6
Mean Number Days with Sky Cover Equal to or Less than 30% and Visibility Equal to or Greater than 3 miles (4.828 km)															
at 1600 LST	days	22.60	23.00	27.00	28.70	30.40	28.80	30.80	30.40	26.60	27.20	25.00	26.80	327.30	5
at 2200 LST	days	23.00	22.70	26.50	28.50	29.00	27.30	30.30	30.70	28.40	26.50	23.30	23.70	319.90	6
at 0400 LST	days	22.30	22.40	25.80	26.00	26.50	23.30	25.30	25.00	21.30	22.00	23.30	23.30	286.50	6
at 1000 LST	days	23.20	21.90	23.30	26.80	28.60	24.80	27.60	27.80	24.00	22.60	22.60	25.80	299.00	6
Mean Number Days with Ceiling Equal to or Greater than 1,000 ft (304.8 m) and Visibility Equal to or Greater than 3 miles (4.828 km)															
at 1600 LST	days	12.40	9.90	10.20	16.00	17.80	19.20	23.40	22.60	23.00	18.20	14.10	9.60	196.40	5
at 2200 LST	days	9.80	11.30	11.70	16.50	17.00	16.00	22.70	21.30	22.40	16.50	11.50	9.40	186.10	6
at 0400 LST	days	9.80	8.90	9.30	14.00	13.00	12.00	16.30	14.30	16.00	10.00	10.50	9.60	143.70	6
at 1000 LST	days	9.80	9.90	8.80	14.00	15.00	16.60	18.60	16.60	19.40	11.00	12.20	9.60	160.20	6
Mean Number Days with Ceiling Equal to or Greater than 2,000 ft (609.6 m) and Visibility Equal to or Greater than 3 miles (4.828 km) and Surface Wind Equal to or Less than 10 knots (11.15 mph or 18.53 kmph)															
at 1600 LST	days	9.20	14.10	15.20	21.50	23.80	25.40	27.00	28.40	22.00	22.00	12.60	11.30	232.70	5
at 2200 LST	days	9.30	15.00	20.00	25.70	27.00	27.30	30.00	30.70	27.00	21.00	12.80	11.80	257.90	6
at 0400 LST	days	10.70	13.80	18.20	22.20	27.00	24.00	27.30	26.00	22.00	17.70	13.20	10.20	232.30	6
at 1000 LST	days	10.00	11.50	12.80	18.40	25.80	23.80	27.20	28.40	18.60	15.40	9.00	10.60	211.50	6
Mean Number Days with Ceiling Equal to or Greater than 2,500 ft (762.0 m) and Visibility Equal to or Greater than 3 miles (4.828 km)															
at 1600 LST	days	22.60	23.00	27.00	28.70	30.40	28.80	30.80	30.40	26.60	27.20	25.00	26.80	327.30	5
at 2200 LST	days	23.00	22.70	26.50	28.50	29.00	27.30	30.30	30.70	28.40	26.50	23.30	23.70	319.90	6
at 0400 LST	days	22.30	22.40	25.80	26.00	26.50	23.30	25.30	25.00	21.30	22.00	23.30	23.30	286.50	6
at 1000 LST	days	23.20	21.90	23.30	26.80	28.60	24.80	27.60	27.80	24.00	22.60	22.60	25.80	299.00	6
Mean Number Days with Ceiling Equal to or Greater than 6,000 ft (1,828.8 m) and Visibility Equal to or Greater than 3 miles (4.828 km)															
at 1600 LST	days	14.10	12.40	14.00	18.50	23.60	20.20	25.00	26.00	24.20	19.50	16.10	13.20	226.80	5
at 2200 LST	days	13.30	14.00	15.70	19.20	22.30	19.70	24.30	23.70	23.70	19.00	14.30	11.80	221.00	6
at 0400 LST	days	13.10	11.20	13.10	16.00	15.50	15.70	16.60	17.00	17.60	13.50	12.50	11.30	173.10	6
at 1000 LST	days	12.20	13.00	11.80	18.20	16.60	16.80	20.80	19.60	20.60	13.60	15.60	12.60	191.40	6
Mean Number Days with Ceiling Equal to or Greater than 10,000 ft (3,048.0 m) and Visibility Equal to or Greater than 3 miles (4.828 km)															
at 1600 LST	days	12.40	9.90	10.20	16.00	17.80	19.20	23.40	22.60	23.00	18.20	14.10	9.60	196.40	6
at 2200 LST	days	9.80	11.30	11.70	16.50	17.00	16.00	22.70	21.30	22.40	16.50	11.50	9.40	186.10	6
at 0400 LST	days	9.80	8.90	9.30	14.00	13.00	12.00	16.30	14.30	16.00	10.00	10.50	9.60	143.70	6
at 1000 LST	days	10.50	9.90	8.80	14.00	15.00	14.60	18.60	16.60	19.40	11.00	12.20	9.60	160.20	6

TABLE H-4, EPHEMERIS (PACIFIC STANDARD TIME)[5]

DATE	NAUTICAL TWILIGHT BEGINNING	NAUTICAL TWILIGHT END	SUNRISE	SUNSET
Jan 1	0639	1748	0751	1636
Jan 11	0638	1758	0749	1647
Jan 21	0634	1809	0743	1700
Feb 1	0624	1823	0732	1716
Feb 11	0612	1836	0718	1730
Feb 21	0558	1850	0703	1745
Mar 1	0545	1900	0649	1756
Mar 11	0526	1914	0630	1810
Mar 21	0507	1928	0611	1823
Apr 1	0445	1944	0550	1838
Apr 11	0424	1959	0532	1851
Apr 21	0404	2014	0514	1904
May 1	0344	2031	0458	1917
May 11	0326	2047	0444	1929
May 21	0311	2103	0432	1941
Jun 1	0258	2118	0424	1952
Jun 11	0251	2128	0420	1959
Jun 21	0250	2132	0420	2003
Jul 1	0255	2131	0424	2003
Jul 11	0305	2125	0431	1959
Jul 21	0318	2113	0440	1951
Aug 1	0335	2056	0453	1939
Aug 11	0350	2038	0504	1924
Aug 21	0406	2018	0517	1908
Sep 1	0422	1956	0530	1848
Sep 11	0437	1935	0543	1829
Sep 21	0450	1914	0555	1810
Oct 1	0503	1854	0608	1750
Oct 11	0516	1836	0621	1732
Oct 21	0529	1819	0634	1714
Nov 1	0543	1803	0649	1657
Nov 11	0556	1751	0703	1644
Nov 21	0608	1743	0717	1633
Dec 1	0619	1738	0730	1627
Dec 11	0628	1737	0740	1625
Dec 21	0635	1740	0747	1628

[1]Climatic information derived from data collected by the weather station of the Troutdale Airport, Oregon, located latitude 45°33′N, Longitude 122°24′W, elevation 8.8 meters (29 feet), 16.1 kilometers (10 miles) south of Camp Bonneville.
[2]Data not available for Troutdale Airport. Figures given are for data collected at Portland, Oregon, located approximately 20.9 kilometers (13 miles) southwest of Camp Bonneville.
[3]T = Trace.
[4]LST = Local Standard Time.
[5]Ephemeris provided by National Almanac Office, U.S. Naval Observatory, for Latitude 45°42′N, Longitude 122°25′W.

YAKIMA FIRING CENTER

The Yakima Firing Center lies in the climatic shadows of the Cascade Mountains midway between the mild maritime climate of the Washington coastal region to the west and the rigorous Rocky Mountain climate to the east. The maritime air from the Pacific loses much of its moisture as it is carried by the prevailing western winds over the Cascade Range and then becomes warmer and drier as it descends the eastern slopes. The climate is characteristically dry year-round with cool to cold winters and warm summers.

In the winter frequent changes in weather occur as a result of Pacific Ocean weather systems mixing with the cold interior air of Canada. Mean daily maximum temperatures in the winter range from 2.22°C to 7.22°C (36°F to 45°F) and mean daily minimum temperatures range from −7.78°C to −3.89°C (18°F to 25°F). The coldest month is January, although the coldest temperature of record, −31.67°C (−25°F), was in February. During the summer, temperatures range from a mean daily maximum of 26.11°C to 31.67°C (79°F to 89°F) and mean daily minimum of 9.44°C to 10.56°C (49°F to 51°F). The warmest month is July, but the hottest temperature of record, 42.22°C (108°F), was in August. Lack of cloud cover and atmospheric moisture, typical of arid areas, permits ground heat to escape at night which causes the night air to become cool. The frost free season has an average of 186 days; the average date of the last killing frost is 17 April and the average date of the first killing frost is 20 October.

The amount of annual precipitation is small, 223.52 mm (8.8 in). Summers are warm and exceedingly dry; the driest areas are those at the lowest elevations. The total precipitation for the months of July, August and September is only 16.8 mm (0.66 in). Only in two months of the year, December and January, is there over 25.4 mm (1 in) of precipitation, and this is partly in the form of snow. The mean snowfall amounts to 652.78 mm (27.7 in). Snow remains on the ground from a few days to as much as eight weeks, dependent partly on elevation; the higher ridges retain the snow for longer periods.

Prevailing winds are from the west. The strongest winds occur during March and April; for more than 7 percent of the time in this period they exceed a velocity of 17 knots (31.5 kmph or 19.7 mph). During the rest of the year, winds are mostly light, wind speeds for the year average about 7.8 knots (14.5 kmph or 9 mph). Warm chinook winds, formed by air flowing down the eastern slopes of the Cascade Range, are a unique springtime occurrence and one that is of particular benefit to early spring crops. The fastest one minute or longer wind speed recorded is 41.7 knots (75 kmph or 45 mph). The peak gust is 59.9 knots (111.0 kmph or 69 mph). Blizzards, tornadoes and destructive hail storms are rare.

Wind chill generally presents no problems. On rare occasions, wind chill may reach a factor of −37.22°C (−35°F) which is considered in the increasing danger zone where flesh could freeze within a one minute period.

Visibility is best in summer when the area receives 85 percent of all possible sunshine and there is a general lack of atmospheric moisture. In the winter it is generally cloudy with only 33 percent of possible sunshine occurring. The mean number of days with heavy fog in December is seven while November and January both have four. During April through September, heavy fog does not occur. Basic climatic and ephemerical information for the Yakima Firing Center is provided in the following tables.

TABLE H-5, TEMPERATURE, PRECIPITATION, HUMIDITY, WIND AND VISIBILITY[1]

PARAMETER DESCRIPTION	UNIT OF MEASURE	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC	ANNUAL	YEARS OF RECORD
Temperature															
Absolute Maximum Temperature	°C	17.78	18.33	26.67	30.56	36.67	39.44	40.56	42.22	36.11	29.44	21.11	16.67	42.22	12
	°F	64.00	65.00	80.00	87.00	98.00	103.00	105.00	108.00	97.00	85.00	70.00	62.00	108.00	12
Mean Daily Maximum Temperature	°C	2.22	7.22	11.67	17.78	22.78	26.11	31.67	30.00	25.56	17.78	8.33	3.89	17.22	12
	°F	36.00	45.00	53.00	64.00	73.00	79.00	89.00	86.00	78.00	64.00	47.00	39.00	63.00	12
Mean Daily Minimum Temperature	°C	−7.78	−3.89	−2.22	1.11	5.56	9.44	11.67	10.56	6.11	1.67	−3.33	−3.89	2.22	12
	°F	18.00	25.00	28.00	34.00	42.00	49.00	53.00	51.00	43.00	35.00	26.00	24.00	36.00	12
Absolute Minimum Temperature	°C	−29.44	−31.67	−18.33	−6.11	−3.89	0.56	1.67	1.67	−1.67	−7.78	−19.44	−18.89	−31.67	12
	°F	−21.00	−25.00	−1.00	21.00	25.00	33.00	35.00	35.00	29.00	18.00	−3.00	−2.00	−25.00	12
Mean Number Days with Maximum Temperatures Equal to or Greater than 90°F (32.2°C)	days	0.00	0.00	0.00	0.00	1.40	4.00	15.70	11.20	2.80	0.00	0.00	0.00	35.10	12
Mean Number Days with Minimum Temperatures Equal to or Less than 32°F (0.0°C)	days	29.10	24.30	22.80	12.90	3.00	0.00	0.00	0.00	1.10	10.30	23.40	28.60	155.70	12
Normal Heating Degree Days (Base 65°F, 18.3°C)	degree days	1157.00	692.00	652.00	433.00	329.00	72.00	44.00	8.00	79.00	852.00	706.00	917.00	5541.00	—
Normal Cooling Degree Days (Base 65°F, 18.3°C)	degree days	0.00	0.00	0.00	0.00	3.00	174.00	153.00	192.00	24.00	0.00	0.00	0.00	546.00	—
Mean Dew Point Temperature	°C	−6.11	−3.33	−2.78	−1.11	1.11	6.11	7.78	7.78	5.56	2.78	1.67	3.33	1.11	12
	°F	21.00	26.00	27.00	30.00	34.00	43.00	46.00	46.00	42.00	37.00	29.00	26.00	34.00	12
Precipitation															
Mean Monthly Precipitation	mm	40.89	24.89	21.84	13.46	15.49	22.10	3.05	5.33	8.38	16.76	25.15	26.67	223.52	12
	in	1.61	0.98	0.86	0.53	0.61	0.87	0.12	0.21	0.33	0.66	0.99	1.05	8.80	12
Absolute Maximum Monthly Precipitation	mm	92.96	62.48	66.80	41.15	70.10	53.34	18.03	43.43	24.89	56.39	71.88	106.43	106.43	28
	in	3.66	2.46	2.63	1.62	2.76	2.10	0.71	1.71	0.98	2.22	2.83	4.19	4.19	28
Absolute Minimum Monthly Precipitation	mm	3.30	T[2]	0.25	T	0.76	0.25	T	0.00	T	0.25	2.03	3.81	0.00	28
	in	0.13	T	0.01	T	0.03	0.01	T	0.00	T	0.01	0.08	0.15	0.00	28
Mean Number Days with Precipitation Equal to or Greater than 0.1 in (2.54 mm)	days	5.20	3.00	2.70	1.80	1.80	2.30	0.60	0.90	1.00	2.70	3.40	3.70	29.00	12
Mean Number Days with Thunderstorms	days	0.00	0.10	0.10	0.30	1.70	1.90	1.60	1.10	0.70	0.10	0.00	0.00	7.60	12
Mean Monthly Snowfall	mm	294.64	88.90	66.04	0.00	0.00	0.00	0.00	0.00	0.00	2.54	60.96	139.70	652.78	12
	in	11.60	3.50	2.60	0.00	0.00	0.00	0.00	0.00	0.00	0.10	2.40	5.50	25.70	12
Mean Snow Depth	mm	256.54	76.20	48.26	T	T	0.00	0.00	0.00	0.00	2.54	43.18	208.28	635.00	39
	in	10.10	3.00	1.90	T	T	0.00	0.00	0.00	0.00	0.10	1.70	8.20	25.00	39
Maximum Snow Depth	mm	675.64	419.10	274.30	T	T	0.00	0.00	0.00	0.00	0.00	0.00	60.96	165.10	28
	in	26.60	16.50	10.80	T	T	0.00	0.00	0.00	0.00	0.00	0.00	2.40	6.50	28
Mean Number Days with Snowfall Equal to or Greater than 1.5 in (38.1 mm)	days	3.10	0.80	0.60	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.60	1.40	6.50	12
Humidity															
Mean Percent Relative Humidity	%	81.00	74.00	62.00	51.00	49.00	49.00	44.00	49.00	56.00	68.00	77.00	83.00	62.00	12
Wind															
Percent Frequency of Surface Wind Speed Equal to or Greater than 28 knots (32.24 mph or 51.9 kmph)	%	0.40	0.40	0.40	0.50	0.20	0.10	0.10	0.00	0.20	0.10	0.30	0.30	0.30	12
Percent Frequency of Surface Wind Speed Equal to or Greater than 17 knots (19.58 mph or 31.5 kmph)	%	3.50	4.40	7.30	7.70	4.80	3.00	2.00	1.50	2.60	3.60	3.50	2.60	3.90	12
Fastest One Minute Wind Speed	knots	38.20	41.70	41.70	39.90	39.90	40.80	37.30	28.60	33.00	33.90	39.10	41.70	41.70	21
	kmph	70.80	75.20	75.20	74.00	74.00	75.60	69.20	53.10	61.10	62.80	72.40	75.20	75.20	21
	mph	44.00	48.00	48.00	46.00	46.00	47.00	43.00	33.00	38.00	39.00	45.00	48.00	48.00	21
Mean Number Days with Surface Wind Equal to or Greater than 17 knots (19.58 mph or 31.5 kmph) and no Precipitation															
at 1600 LST[3]	days	1.80	2.80	5.40	6.20	4.10	2.60	1.50	1.30	1.90	2.70	1.40	0.80	32.50	12
at 2200 LST	days	0.70	0.70	1.30	0.80	0.30	0.30	0.10	0.20	0.50	0.60	1.10	0.50	7.10	12
at 0400 LST	days	1.10	0.90	1.10	0.60	0.20	0.10	0.20	0.10	0.20	0.60	0.80	0.70	6.60	12
at 1000 LST	days	1.10	1.40	2.60	3.20	1.40	0.60	0.30	0.30	0.70	1.20	1.20	0.70	14.70	12
Mean Number Days with Surface Wind 4 to 10 knots (4.61 to 11.52 mph or 7.4 to 18.5 kmph) and Temperature 33° to 89°F (0.6° to 31.7°C) and no Precipitation															
at 1600 LST	days	6.80	10.90	13.00	13.00	14.40	15.90	10.00	13.70	15.50	15.50	12.10	8.10	148.90	12
at 2200 LST	days	4.60	8.20	15.90	19.30	22.90	22.90	24.60	23.30	22.80	22.50	7.40	5.80	200.20	12
at 0400 LST	days	3.40	5.80	8.70	16.00	23.50	23.40	25.40	25.00	24.20	18.30	6.30	3.20	183.20	12
at 1000 LST	days	4.60	9.00	12.60	14.40	19.30	20.40	20.40	19.90	16.90	14.90	10.30	6.90	169.60	12
Visibility															
Mean Number Days with an Occurrence of Visibility Equal to or Less than 0.5 mile (0.8 km)	days	6.10	2.00	0.40	1.50	0.80	0.00	0.00	0.00	0.10	0.40	3.20	7.40	21.90	12
Percent Frequency Ceiling Equal to or Less than 5,000 ft (1,524 m) or Visibility Equal to or Less than 5 miles (8.05 km)	%	48.20	28.40	14.50	8.10	4.50	3.10	0.10	0.30	1.20	8.00	29.30	49.00	16.20	12

YAKIMA FIRING CENTER

TABLE H-5, TEMPERATURE, PRECIPITATION, HUMIDITY, WIND AND VISIBILITY[1] (continued)

PARAMETER DESCRIPTION	UNIT OF MEASURE	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC	ANNUAL	YEARS OF RECORD
Percent Frequency Ceiling Equal to or Less than 1,500 ft (457.2 m) or Visibility Equal to or Less than 3 miles (4.828 km)															
for 0000 to 0200 LST	%	26.30	12.60	3.60	1.70	0.90	0.00	0.00	0.00	0.00	0.60	11.70	32.50	7.50	12
for 0300 to 0500 LST	%	29.80	15.00	4.70	7.00	2.70	0.40	0.00	0.00	0.10	1.40	15.00	34.40	9.20	12
for 0600 to 0800 LST	%	33.20	18.70	6.50	5.00	2.10	0.80	0.10	0.00	0.00	2.20	17.70	38.10	10.40	12
for 0900 to 1100 LST	%	31.00	17.10	4.80	1.10	0.20	0.20	0.00	0.00	0.50	1.70	16.90	36.30	9.20	12
for 1200 to 1400 LST	%	24.60	11.60	3.90	0.30	0.20	0.00	0.00	0.00	0.50	1.00	11.20	31.50	7.10	12
for 1500 to 1700 LST	%	20.30	10.30	2.40	0.10	0.00	0.00	0.00	0.00	0.30	0.90	11.30	29.00	6.20	12
for 1800 to 2000 LST	%	20.50	11.30	2.20	0.40	0.00	0.00	0.00	0.00	0.10	1.40	12.00	29.40	6.40	12
for 2100 to 2300 LST	%	25.00	9.80	2.60	0.30	0.10	0.00	0.00	0.00	0.00	1.20	12.40	30.70	6.80	12
Percent Frequency Ceiling Equal to or Less than 300 ft (91.4 m) or Visibility Equal to or Less than 1 mile (1.609 km)															
for 0000 to 0200 LST	%	7.20	3.10	0.50	0.60	0.40	0.00	0.00	0.00	0.00	0.00	4.20	10.70	2.20	12
for 0300 to 0500 LST	%	8.40	4.60	0.40	4.00	1.80	0.00	0.00	0.00	0.00	0.40	5.40	13.10	3.10	12
for 0600 to 0800 LST	%	10.40	5.10	1.30	2.10	1.20	0.00	0.00	0.00	0.00	1.00	5.80	14.40	3.40	12
for 0900 to 1100 LST	%	6.80	3.20	0.40	0.10	0.00	0.00	0.00	0.00	0.00	0.10	3.30	9.20	1.90	12
for 1200 to 1400 LST	%	2.70	0.60	0.40	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.60	6.00	0.90	12
for 1500 to 1700 LST	%	3.00	0.30	0.30	0.00	0.00	0.00	0.00	0.00	0.10	0.00	0.50	5.50	0.80	12
for 1800 to 2000 LST	%	3.90	0.60	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	2.70	6.30	1.10	12
for 2100 to 2300 LST	%	5.40	2.30	0.40	0.00	0.10	0.00	0.00	0.00	0.00	0.00	3.50	8.80	1.70	12
Mean Number Days with Sky Cover Equal to or less than 30% and Visibility Equal to or Greater than 3 miles (4.828 km)															
at 1600 LST	days	4.00	4.40	5.70	7.10	7.20	9.30	20.20	18.00	14.30	9.30	6.00	3.90	109.40	12
at 2200 LST	days	6.70	8.80	13.10	14.30	15.50	16.40	23.60	23.30	18.90	14.70	9.60	7.20	172.10	12
at 0400 LST	days	6.30	8.20	12.30	12.80	12.10	12.80	23.10	21.70	20.20	15.20	11.20	6.90	162.80	12
at 1000 LST	days	4.20	5.40	7.20	8.60	9.80	11.10	22.20	19.80	15.70	10.70	6.60	4.10	125.40	12
Mean Number Days with Ceiling Equal to or Greater than 1,000 ft (304.8 m) and Visibility Equal to or Greater than 3 miles (4.828 km)															
at 1600 LST	days	13.80	18.10	21.00	22.90	23.30	23.50	29.50	28.10	27.20	24.20	19.20	15.10	265.90	12
at 2200 LST	days	13.00	17.10	21.90	25.10	25.20	26.60	29.80	29.40	27.30	24.20	18.50	13.90	272.00	12
at 0400 LST	days	12.10	16.40	21.30	23.20	23.60	25.70	29.60	29.00	27.00	24.90	18.30	12.70	263.80	12
at 1000 LST	days	11.70	16.60	21.90	24.70	24.70	24.80	29.80	30.10	27.60	24.10	18.50	12.80	267.30	12
Mean Number Days with Ceiling Equal to or Greater than 2,000 ft (609.6 m) and Visibility Equal to or Greater than 3 miles (4.828 km) and Surface Wind Equal to or Less than 10 knots (11.15 mph or 18.53 kmph)															
at 1600 LST[3]	days	20.00	17.80	16.70	16.40	18.90	19.30	23.30	25.00	23.40	23.30	21.70	17.80	243.60	12
at 2200 LST	days	20.20	21.30	26.20	24.20	26.20	25.20	25.80	27.30	26.50	27.20	23.10	18.50	291.70	12
at 0400 LST	days	18.70	21.10	25.30	24.70	26.60	27.10	26.40	27.10	25.50	27.80	23.20	16.70	290.20	12
at 1000 LST	days	17.80	19.90	22.10	21.30	24.20	26.20	27.70	28.50	26.70	27.40	22.50	17.00	281.30	12
Mean Number Days with Ceiling Equal to or Greater than 2,500 ft (762.0 m) and Visibility Equal to or Greater than 3 miles (4.828 km)															
at 1600 LST	days	22.10	23.40	29.80	29.90	31.00	30.00	31.00	31.00	29.90	29.60	25.10	20.20	333.00	12
at 2200 LST	days	22.20	22.60	29.40	29.60	31.00	30.00	31.00	31.00	30.00	29.80	24.80	19.50	330.90	12
at 0400 LST	days	19.70	22.50	29.00	27.80	30.00	29.90	31.00	31.00	29.70	29.80	24.20	18.40	323.00	12
at 1000 LST	days	19.20	21.60	28.30	29.60	30.90	29.60	31.00	31.00	29.80	29.80	24.10	18.10	323.00	12
Mean Number Days with Ceiling Equal to or Greater than 6,000 ft (1,828.8 m) and Visibility Equal to or Greater than 3 miles (4.828 km)															
at 1600 LST	days	16.40	20.60	24.60	27.20	27.90	28.00	30.70	30.70	29.20	27.60	21.50	17.00	301.40	12
at 2200 LST	days	16.00	19.20	25.80	27.60	29.30	28.90	31.00	30.80	29.40	28.10	20.80	16.00	303.40	12
at 0400 LST	days	14.30	19.10	25.60	26.10	28.20	28.30	30.80	30.70	29.30	27.30	20.60	14.60	294.90	12
at 1000 LST	days	14.70	18.60	25.60	27.10	28.80	27.40	30.80	30.70	29.50	27.60	20.30	14.40	295.50	12
Mean Number Days with Ceiling Equal to or Greater than 10,000 ft (3,048.0 m) and Visibility Equal to or Greater than 3 miles (4.828 km)															
at 1600 LST	days	13.80	18.10	21.00	22.90	23.30	23.50	29.50	28.10	27.20	24.20	19.20	15.10	265.90	12
at 2200 LST	days	13.00	17.10	21.90	25.10	25.20	26.60	29.80	29.40	27.30	24.20	18.50	13.90	272.00	12
at 0400 LST	days	12.10	16.40	21.30	23.20	23.60	25.70	29.60	29.00	27.00	24.90	18.30	12.70	263.80	12
at 1000 LST	days	11.70	16.60	21.90	24.70	24.70	24.80	29.80	30.10	27.60	24.10	18.50	12.80	267.30	12

TABLE H-6, EPHEMERIS (PACIFIC STANDARD TIME)[4]

DATE	NAUTICAL TWILIGHT BEGINNING	NAUTICAL TWILIGHT END	SUNRISE	SUNSET
Jan 1	0633	1738	0745	1625
Jan 11	0632	1748	0744	1636
Jan 21	0627	1800	0738	1649
Feb 1	0618	1814	0726	1705
Feb 11	0605	1828	0712	1720
Feb 21	0550	1842	0656	1736
Mar 1	0537	1853	0642	1747
Mar 11	0518	1907	0623	1802
Mar 21	0458	1921	0603	1816
Apr 1	0435	1938	0542	1831
Apr 11	0413	1954	0522	1844
Apr 21	0352	2010	0504	1858
May 1	0332	2027	0447	1911
May 11	0313	2044	0433	1924
May 21	0257	2101	0421	1936
Jun 1	0243	2117	0412	1948
Jun 11	0236	2127	0408	1955
Jun 21	0235	2132	0408	1959
Jul 1	0239	2131	0412	1959
Jul 11	0250	2124	0419	1955
Jul 21	0304	2111	0429	1947
Aug 1	0321	2053	0442	1934
Aug 11	0338	2035	0454	1919
Aug 21	0355	2014	0507	1902
Sep 1	0412	1950	0521	1841
Sep 11	0427	1929	0534	1822
Sep 21	0441	1908	0547	1802
Oct 1	0455	1847	0600	1742
Oct 11	0508	1828	0614	1723
Oct 21	0522	1811	0628	1705
Nov 1	0536	1754	0644	1647
Nov 11	0549	1742	0658	1633
Nov 21	0602	1733	0715	1623
Dec 1	0613	1728	0725	1616
Dec 11	0623	1727	0736	1614
Dec 21	0630	1730	0743	1616

[1] Climatic information derived from data collected by the weather station at the Yakima Municipal Airport, Latitude 46° 34'N, Longitude 120° 32'W, Elevation 320.65 m (1,052 ft).
[2] T = Trace.
[3] LST = Local Standard Time.
[4] Ephemeris provided by Nautical Almanac Office, U.S. Naval Observatory, for Latitude 46° 41'N, Longitude 120° 27'W.

I. CROSS-COUNTRY MOVEMENT

FORT LEWIS AND CAMP BONNEVILLE

Cross-Country Movement (CCM) conditions at Fort Lewis and Camp Bonneville are shown on the accompanying map. Additional details are provided in the following text and table. CCM conditions have been derived mainly from vegetation and engineering soils data prepared for and appearing separately in this terrain analysis and from 1:12,000-scale (approx.) aerial photography dated May 1970. Supplemental sources included topographic maps, field notes and miscellaneous textual material. Changes to the landscape since about 1970, such as timber cuttings, are not reflected in the analysis. The tabular data presented combines both Fort Lewis and Camp Bonneville since the environmental conditions affecting cross-country movement are similar.

The map and predicted movement evaluations should be used only as guides in planning military training activities. For exact movement routes, reconnaissance on the ground is required.

FORT LEWIS:
Off-road movement at Fort Lewis is mainly predicated on the presence or absence of wooded vegetation. Movement conditions on the natural prairies and cleared or otherwise open areas (Map Unit 1) are good throughout the year. In these areas the sandy or gravelly soils are well drained, and even when wet, soil strength is sufficient to support numerous passes of most military vehicles. On the other hand, forested tracts, dominated by Douglas-fir, (Map Unit 4) are largely impassable to vehicles due to closely spaced trees. Swamps, marshes and poorly drained flats (Map Unit 5), many too small to show at the scale of mapping, are generally unsuited for vehicular movement.

CAMP BONNEVILLE:
At Camp Bonneville, terrain conditions that adversely affect movement are more complex. The interaction of steep slopes, forested tracts and recently logged areas, are principal considerations to cross-country movement. Soft and clayey, poorly drained soils in bottomland positions commonly hinder vehicular movement during the rainy winter months.

TABLE I-1, CROSS-COUNTRY MOVEMENT

MAP UNIT	GENERALIZED TERRAIN CONDITIONS	MOVEMENT OF TRACKED VEHICLES[1]	MOVEMENT OF WHEELED VEHICLES[2]	MOVEMENT OF FOOT TROOPS
1	Dominantly open cleared areas and natural prairies. Nearly level to gently undulating terrain. Most slopes less than 3 percent. Soils predominantly well drained, gravelly and/or sandy; good bearing strength throughout year except in a few small depressional areas. Vegetation consists of short grasses and miscellaneous forbs. Grass sparse or ground bare where training activities are concentrated. At Camp Bonneville, soils of this map unit mainly clayey and in bottomland positions; subject to seasonal wetness during period of winter rains. When wet, soil strength severely degraded.	Easy in all directions at all times; movement limited only by natural boundaries of the open areas. Small depressions and other local natural or man-made obstacles easily bypassed. At Camp Bonneville movement moderately hindered in bottomlands by soft clayey soils. These degraded movement conditions prevail only during parts of the winter months.	Generally the same as for tracked vehicles. Movement at Camp Bonneville very difficult during and after rains when clayey soils in the bottomlands are wet and soft.	Unrestricted at Fort Lewis. Movement at Camp Bonneville somewhat slowed by muddy soil conditions during and after winter rains.
2	Sparsely forested plains with many grass or shrub-covered openings. Areas commonly represent incomplete cut-over lands. Slopes average between 2 and 6 percent. At Camp Bonneville, slopes considerably steeper. Soils mainly gravelly and/or sandy with good bearing strength and traction capacity maintained throughout year. Soils covering Camp Bonneville clayey and stony; ground surface uneven, rough and potentially slippery during wet periods. Trees, mainly coniferous, distributed randomly. Size and spacing highly varied. Scattered logs and stumps locally common.	Slightly slowed by randomly spaced trees and small forested tracts. Movement unrestricted in openings but detouring required around scattered trees and forested tracts. Careful observation and driving required to avoid damage to vehicle by scattered logs and stumps which may be obscured by undergrowth.	Severely slowed by scattered trees and small forested tracts. Locally steep slopes at Camp Bonneville impose additional limitations to movement, as do logs and stumps. During wet periods at Camp Bonneville, movement generally impractical due to slipperiness.	Slightly slowed by trees, scattered logs and stumps. At Camp Bonneville, wet and slippery soils during and after winter rains, an additional slight hindrance, particularly when movement is upslope.
3	Dominantly cleared terrain on steep, long slopes of mountain foothills. Mapped only on the Camp Bonneville Reservation. Most slopes between 25 and 45 percent. Soils mainly stony clay loams; slippery when wet. Ground surface rough and very uneven. Vegetation dominantly small bushes, sparse grasses and forbs, and widely distributed trees remaining after logging operations. Old logs, slash debris and firmly rooted stumps common.	Tanks severely slowed by combined effects of steep slopes and rough stony ground. Stumps, logs and slash additional hindrance in many places; risk of vehicle damage high. Many changes in direction or maneuvering required to obtain objective. Movement easiest driving on the contour. Traction degraded when soils wet, particularly when proceeding upslope. Armored Personnel Carrier (APC) also slowed but not as severely as tank.	Infeasible except in small localized areas due to combination of steep slopes, rough stony ground, and debris from logging operations.	Moderately slowed by steep slopes, logs, stumps, slash and rough, uneven ground surface. Severely slowed for brief periods during and shortly after rains due to soil slipperiness.
4	Densely forested terrain. Forests cover nearly level to very steep slopes of glaciated Fort Lewis and upland terraces and mountain footslopes of Camp Bonneville. Trees mainly Douglas-fir together with other coniferous species. Some tracts largely deciduous; these thrive in bottomland and other moist environments. Trunk size of trees commonly ranges from about 10 to 80 centimeters (4 to 31 in.) in diameter; most trees spaced 2 to 5 meters (7 to 16 ft.) apart. Density of undergrowth highly varied; generally densest growth in young forest stands growing in low-lying areas.	Tank and APC movement precluded at all times by large and closely spaced trees. Locally, APC can move along circuitous routes employing much twisting and turning.	Generally precluded by large and closely spaced trees.	Severely slowed by closely spaced trees and undergrowth. Very steep drop-off from glacial uplands to Nisqually Valley at Fort Lewis, difficult to negotiate.
5	Swamps, marshes and very poorly drained flats. Areas generally ponded or saturated with water throughout year. Soils predominantly soft and spongy; consist of organic matter in varied stages of decomposition (peats and mucks) mixed with mineral soil. Vegetation mainly comprised of sedges and coarse grasses. Some areas contain willow, ash, alder and cedar growing in clumps.	Generally precluded throughout year by soft, saturated or ponded soils. During unusually dry summers a few passes of M-113 APC feasible in some flats and depressions.	Infeasible due to perennially soft and miry soils. M-151 can often make a few passes through dried out flats and depressions. On-ground reconnaissance recommended before making such attempts.	Feasible but generally not practical except in unusually dry years. Main impediments to movement are soft, boggy, water-saturated or ponded soils.

YAKIMA FIRING CENTER

Cross-Country Movement (CCM) conditions at the Yakima Firing Center are shown on the accompanying map. Additional information is provided in the following text and table. The CCM analysis has been based mainly on slope considerations as they affect vehicular movement.

Soil and vegetation factors, which are important considerations in many terrain situations, are comparatively insignificant at Yakima. Only when the ground is wet, usually for very brief periods during winter rains or early spring thaws, is movement adversely affected by soft, miry or slippery soils.

The map and predicted movement evaluations should be used only as guides in planning military training activities. For exact movement routes, reconnaissance on the ground is required.

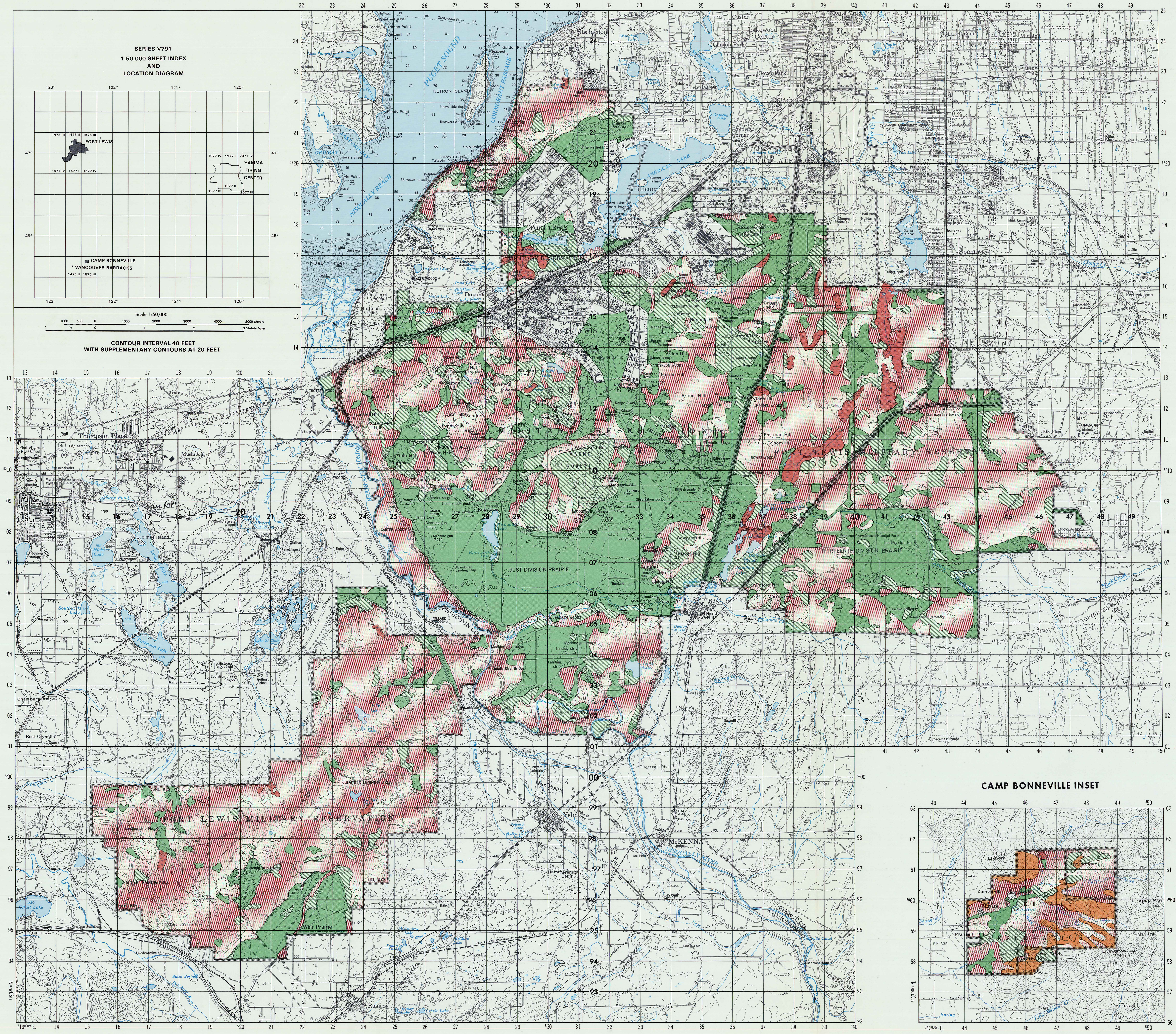
Movement is easy over large areas of nearly level to undulating terrain consisting of slopes less than 8 percent (Map Unit 1). However, high speed vehicular movement during maneuvers may generate clouds of dust which impair visibility. This potential dust problem is particularly acute where surficial silty soils have been disturbed and loosened by previous traffic. With increased slope and attendant dissection, vehicular movement becomes increasingly slow and more difficult. On very steep terrain, mainly in deeply entrenched canyon areas, movement is precluded at all times.

Foot troop movement is generally feasible throughout the Center at all times of the year.

TABLE I-2, CROSS-COUNTRY MOVEMENT

MAP UNIT	GENERALIZED TERRAIN CONDITIONS	MOVEMENT OF TRACKED VEHICLES[1]	MOVEMENT OF WHEELED VEHICLES[2]	MOVEMENT OF FOOT TROOPS
1	Nearly level to undulating terrain; most slopes less than 8 percent. Occurs throughout Center at all elevations and includes smooth ridge flanks and divides, terraces, alluvial fans and bottomlands. Soils mainly silt loams; some stony areas. Soils generally dry and firm all year.[3] Surfaces become powdery and dusty when loosened by traffic. Vegetation chiefly range grasses and forbs including much sagebrush.	Unrestricted in all directions. High speed movement possible at all times except for brief periods during thaws. Caution required when crossing drainageway channels. Visibility may be impaired in maneuver areas due to dust.	Generally the same as for tracked vehicles.	Easy at all times except slowed when ground snow-covered or when soils soft and slippery during thaw periods. Slowed in areas of thick sagebrush.
2	Rolling to hilly terrain; most slopes between 8 and 30 percent. Most extensive unit mapped. Soils silty; locally ground surfaces stony. Areas crossed by many drainageways or gullies paralleling each other. Spacing of drainageways commonly 0.5 to 1.5 kilometers (0.3 to 1 mile). Drains flow only after unusually heavy winter rains or rapid snowmelt. Vegetation essentially same as in map unit 1.	Moderately slowed by steep slopes. In hilly areas movement easiest on ridge divides. Movement on the contour more difficult due to necessity of crossing drainageway and gully channels. Severely slowed, especially on the steeper slopes, when soils briefly soft and miry.	2 1/2 ton truck severely slowed by locally steep slopes, particularly when loaded or when movement requires crossing numerous drainageway channels. Movement of 1/4 ton truck easier than for 2 1/2 ton truck. Impractical movement during periods of snow cover or when soils wet, miry or slippery. In some areas sharp-edged rocks may cause tire damage.	Fairly easy most of year. More difficult when ground snow-covered or when soils soft and slippery.
3	Steeply sloping terrain; most slopes between 30 and 45 percent. Occurs most extensively on side slopes of Alkali Canyon and Hanson Creek Valley; also flanks of Yakima Ridge, Umtanum Ridge and Saddle Mountains. Soils mainly stony silt loams. Vegetation sparse range grasses and forbs.	Severely slowed and choice of direction restricted by steep slopes. In many areas routes must be carefully selected to avoid excessively steep, rough terrain. Movement generally best on narrow divides or in narrow valley troughs. APC movement generally less restricted than for a tank. Impractical for brief periods when soils soft, miry or slippery or when ground snow-covered.	Precluded for 2 1/2 ton truck by steep slopes; locally feasible for short distances, mainly on narrow divides. Movement of 1/4 ton truck difficult but feasible in most places; very cautious driving required at all times. Precluded when soils soft, miry or slippery, or when ground snow-covered.	Moderately slowed by steep slopes and stony soils. Additionally hindered for brief periods by snow-covered ground or slippery soils.
4	Very steep terrain; some slopes precipitous. Most slopes between 45 and 70 percent. Mapped areas include parts of deeply entrenched canyons such as Selah Creek Canyon, Alkali Canyon and Corral Canyon. Ground surface stony; many basalt rock outcrops. Vegetation sparse grasses and forbs. Extensive areas with little or no vegetation.	Precluded at all times by very steep slopes. Some local movement feasible along narrow canyon bottoms.	Precluded at all times by very steep slopes.	Feasible but slow and difficult due to steep, and in some places, near-vertical slopes.

[1]Comments apply to the M-60 tank and the M-113 armored personnel carrier (APC).
[2]Comments apply to the M-35 2 1/2 ton truck and the M-151 1/4 ton truck.
[3]In some winters, ground covered with snow, particularly at higher elevations. Rapid snowmelt may occur, usually in late February or March, induced by warm, dry "Chinook" winds. Under these conditions soils become soft, miry or slippery for brief periods of a few days to a week. These same soil conditions may also prevail for a day or two after unusually heavy winter rains. Otherwise, soils dry or moist are firm.



CAMP BONNEVILLE INSET

FORT LEWIS, WASHINGTON

(Including Camp Bonneville, Vancouver Barracks and Yakima Firing Center)

TERRAIN ANALYSIS

CROSS-COUNTRY MOVEMENT

FORT LEWIS-CAMP BONNEVILLE

NOTE

This map deals with cross-country movement, or movement away from roads, and is primarily intended for use in planning operations. For determining exact driving routes, reconnaissance on the ground is required. Data on the terrain factors and the evaluations are generalized to suit the scale of the map. Many areas of minor areal extent, such as small tracts of forest, cleared areas, and depressions, are too small to portray. The predicted movement ratings are those believed to prevail in most years. Variations in these evaluations may occur from year to year and even within a season due to abnormal variations in the weather. The evaluations are based on terrain conditions as they appeared on large scale aerial photography, dated 1970. Alterations to the terrain since that date, such as land clearing operations, may have modified map unit boundaries or changed cross-country movement conditions from those shown here.

EVALUATION OF TERRAIN FOR CROSS-COUNTRY MOVEMENT

MAP UNIT	TERRAIN UNIT	PREDICTED MOVEMENT RATINGS FOR:				
		TANK (M-60)	APC (M-113)	2½t. TRUCK (M-35)	¼t. TRUCK (M-151)	FOOT TROOPS
1	Dominantly open cleared areas and natural prairies.	Good	Good	Good	Good	Good
2	Sparsely forested plains with many grass or shrub-covered openings.	Fair	Fair	Poor	Poor	Fair
3	Dominantly cleared terrain on steep slopes of mountain foothills. (Camp Bonneville only)	Poor	Fair	Unsuited	Unsuited	Fair
4	Densely forested terrain.	Unsuited	Unsuited	Unsuited	Unsuited	Poor
5	Swamps, marshes and very poorly drained flats.	Unsuited	Unsuited	Unsuited	Unsuited	Poor

Number refers to entry in table.

EXPLANATION OF RATING TERMS

Good — Conditions permit free movement in any direction. Terrain will permit 12 or more passes in trace of an M-60 tank or permit at least one maneuver (starts, stops, sharp turns, or crossing of tracks) at one location.

Fair — Conditions moderately hinder progress or moderately restrict choices of direction for movement. Terrain will permit 3 to 12 passes in trace of an M-60 but maneuvering will be difficult.

Poor — Conditions severely hinder progress or greatly restrict choice of movement routes. Terrain will probably permit up to 3 passes in trace of an M-60. Very cautious driving required. Movement in trace should be avoided.

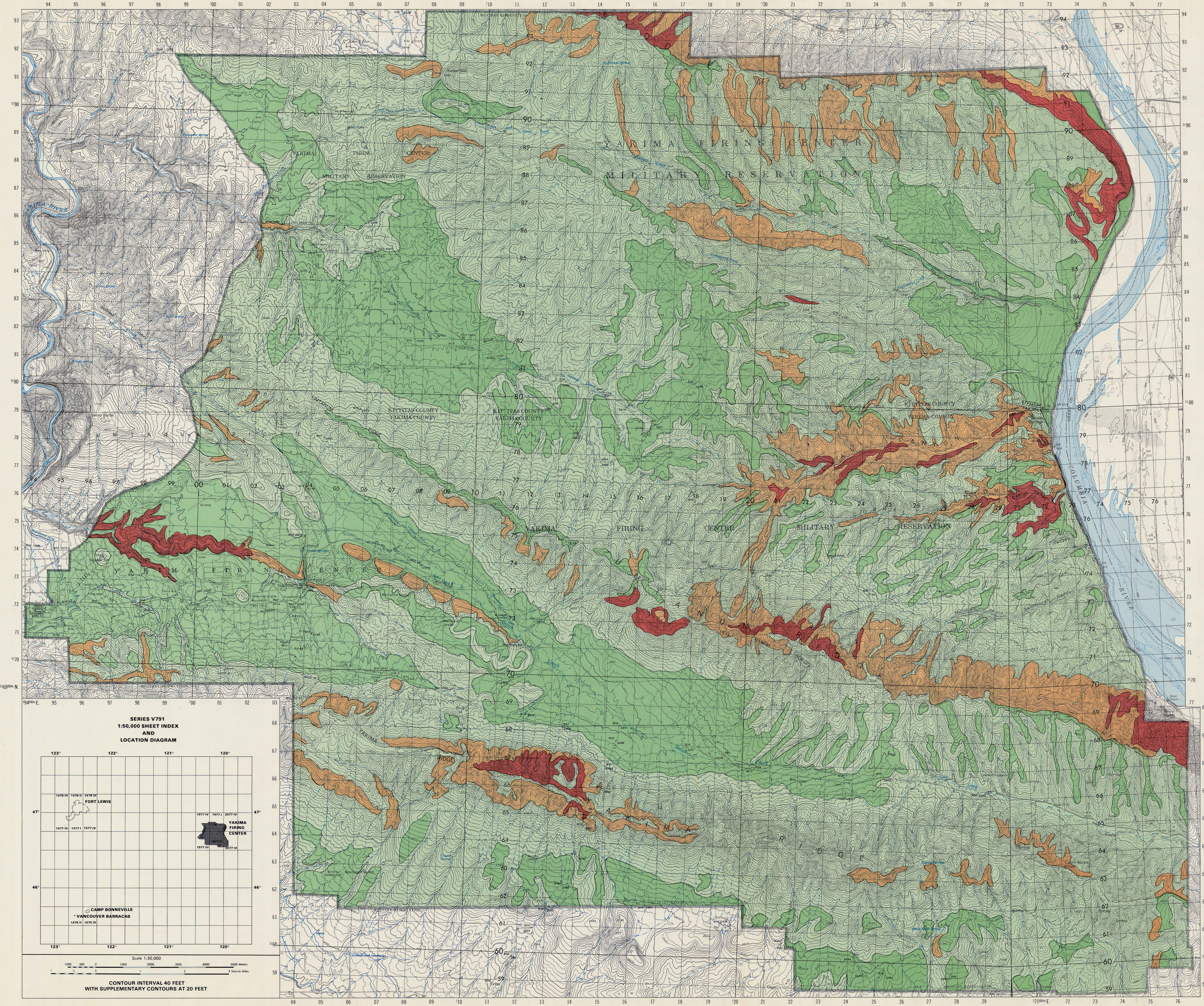
Unsuited — Conditions preclude all but local movement. Engineer work required for vehicular movement.

Prepared by the Terrain Analysis Center, U. S. Army Engineer Topographic Laboratories, Fort Belvoir, Virginia, March 1977. Cartographic and Reproduction Support by the Defense Mapping Agency Hydrographic/Topographic Center, Washington, D. C. December 1978.

FORT LEWIS, WASHINGTON

(Including Camp Bonneville, Vancouver Barracks and Yakima Firing Center)

TERRAIN ANALYSIS



CROSS-COUNTRY MOVEMENT

YAKIMA FIRING CENTER

NOTE

This map deals with cross-country movement, or off-road movement, and is primarily intended for use in planning operations. For determining exact driving routes, reconnaissance on the ground is required. Map unit delineations and terrain data have been generalized to suit study objectives and map scale.

Many areas of small but significant areal extent, such as highly dissected, very steep slopes, are too small to portray. The predicted movement ratings are those believed to prevail in most years. Variations in these evaluations may occur from year to year or even in a season due to abnormal weather conditions.

EVALUATION OF TERRAIN FOR CROSS-COUNTRY MOVEMENT

MAP UNIT	TERRAIN UNIT	PREDICTED MOVEMENT RATINGS FOR*				
		TANK (M-60)	APC (M-113)	2½t. TRUCK (M-35)	¼t. TRUCK (M-151)	FOOT TROOPS
1	Nearly level to undulating terrain; most slopes less than 8 percent.	Good	Good	Good	Good	Good
2	Rolling to hilly terrain; most slopes between 8 and 30 percent.	Fair	Fair	Poor	Fair	Good
3	Steeply sloping terrain; most slopes between 30 and 45 percent.	Poor	Fair	Unsuited	Poor	Fair
4	Very steep terrain; most slopes between 45 and 70 percent.	Unsuited	Unsuited	Unsuited	Unsuited	Poor

*For brief periods during winter and early spring months, movement conditions may be significantly degraded by soft, miry or slippery soils caused by rains or snowmelt.

Number refers to entry in table.

EXPLANATION OF RATING TERMS

Good — Conditions permit free movement in any direction. Terrain will permit 12 or more passes in trace of an M-60 tank or permit at least one maneuver (starts, stops, sharp turns, or crossing of tracks) at one location.

Fair — Conditions moderately hinder progress or moderately restrict choices of direction for movement. Terrain will permit 3 to 12 passes in trace of an M-60 but maneuvering will be difficult.

Poor — Conditions severely hinder progress or greatly restrict choice of movement routes. Terrain will probably permit up to 3 passes in trace of an M-60. Very cautious driving required. Movement in trace should be avoided.

Unsuited — Conditions preclude all but local movement. Engineer work required for vehicular movement.

Prepared by the Terrain Analysis Center, U. S. Army Engineer Topographic Laboratories, Fort Belvoir, Virginia, March 1977. Cartographic and Reproduction Support by the Defense Mapping Agency Hydrographic/Topographic Center, Washington, D. C. December 1978.

J. LINES OF COMMUNICATIONS

FORT LEWIS

Lines of Communications (LOC) at Fort Lewis are depicted on the accompanying LOC map. Supportive information for LOC as shown on the graphic is provided in Tables J-1 through J-9 following this summary. ROADS: The existing road network is a complex system of routes spanning a range of categories from all-weather, hard surface to fair-weather unimproved dirt roads. The length of the entire installation road system, excluding logging roads, is approximately 1,150 kilometers (715 miles), of which 303 kilometers (188 miles) are hard surface. Only selected roads within this total network are shown on the map. Many minor hard surface and dirt roads have been omitted from the graphic. Selected dirt roads depict prevailing patterns and system connections. The length of the system shown on the map is approximately 867 kilometers (539 miles). Refer to table J-1, Roads, *Fort Lewis*, for individual road detail. Data on military load classification and road shoulder characteristics are not available. Although it is not a part of the Fort Lewis network, Interstate Route 5, because of its location, is especially important to reservation communications. ROAD BRIDGES AND TUNNELS: There are relatively few road bridges within reservation boundaries. The longest, the Nisqually River Bridge, is 77 meters (252 feet). All bridges are rated as being in good condition but are limited by a maximum civil load classification of 50 tons. Table J-2, Road Bridges, *Fort Lewis*, provides available details pertaining to each bridge. FORDS: Fords shown on the LOC map are limited to commonly used sites that serve as connecting links in the road network. In terms of location, they are heavily concentrated along Muck Creek, particularly north and east of the Thirteenth Division Prairie. The Nisqually River ford located south of the Nisqually River Bridge is an important exception to the Muck Creek concentration. Fording conditions are generally good from May through November. Individual ford characteristics are listed in Table B-4 under the Surface Drainage topic of this analysis. RAILROADS AND RAILROAD BRIDGES: Federally owned track is limited to sidings that service the main cantonment area. Total length is approximately 47 kilometers (30 miles) with a volume of traffic ranging from 75 to 200 cars per month. The government system includes a single bridge located at the west end of Sequalitchew Lake. Tables J-4 and J-5 give additional information. AIRFIELDS/AIRSTRIPS: There are thirteen airstrips and one airfield located within reservation boundaries. Gray Army Airfield, located southeast of the main post, has the operational capability to serve the C-130 transport, but is only utilized for this purpose on a limited basis. All of the thirteen airstrips and Gray Army Airfield can be used for helicopter landings. See Table J-6 for details. PIPELINES: The pipeline network of Fort Lewis consists of eight segments belonging to three companies, the Olympic Pipeline Company, the Washington Natural Gas Company and the Northwest Pipeline Company. Four of the segments carry various refined petroleum products and four natural gas. All segments are depicted on the LOC map. The only pipeline-related tank crossings are those that correspond with road-pipeline intersections. Refer to table J-7 Pipelines for details. HELICOPTER LANDING ZONES (HLZs): As previously mentioned, Gray Airfield and all existing airstrips are used for helicopter landings. There are 25 additional sites designated as HLZs. Most of these sites are grass surfaced with center zone markings. Details are given in Table J-8. DROP ZONES: There are thirteen drop zones on Fort Lewis (Merrill, Darby, Abrahms, Rogers, Dak To, Anzio, Cisteria, Pointe de Hoc, Myitkyina, Yalu (tip), El Guettar, Marion and Cherry Hill). Of the thirteen drop zones, only Merrill, Darby, Abrahms and Rogers are designated as active at the present time; the remainder are considered inactive. For additional data refer to Table J-9 Drop Zones.

TABLE J-1

ROADS

					SURFACE		SHOULDERS	
ROUTE NAME[1]	GRID COORDINATES FROM TO	LENGTH OF ROAD	MILITARY LOAD CLASSIFICATION	ROUTE TYPE	CONSTRUCTION MATERIAL	WIDTH/ CONDITION	CONSTRUCTION MATERIAL	WIDTH/ CONDITION
A Street	30401881–31101965	1.09 km (.68 mi)	No Data	All-weather	Asphaltic Concrete	6.7 m (22 ft)/ Excellent	No Data	No Data
Cemetery Road	31651195–31501295	1.26 km (.78 mi)	No Data	All-weather	Asphaltic Concrete	6.7 m (22 ft)/ Good	No Data	No Data
Collins Road	15209870–17509850	1.90 km (1.18 mi)	No Data	Fair-weather	Dirt	4.6 m (15 ft)/ Good	No Data	No Data
Colorado Avenue	31451595–32651539	1.26 km (.78 mi)	No Data	All-weather	Asphaltic Concrete	6.7 m (22 ft)/ Excellent	No Data	No Data
East Drive	30152050–31101965	1.26 km (.78 mi)	No Data	All-weather	Asphaltic Concrete	6.7 m (22 ft)/ Good	No Data	No Data
East Gate Road	31951260–46450945	16.50 km (10.25 mi)	No Data	All-weather, Fair-weather	Asphaltic Concrete Dirt	6.7 m (22 ft)/ 7.9 m (26 ft)/Good	No Data	No Data
Segment 1	31951260–39300955	8.89 km (5.52 mi)	No Data	All-weather	Asphaltic Concrete	6.7 m (22 ft)/ Good	No Data	No Data
Segment 2	39300955–46450945	7.61 km (4.73 mi)	No Data	Fair-weather	Dirt	7.9 m (26 ft)/ Good	No Data	No Data
East Lincoln Drive	35201635–37901810	3.17 km (1.97 mi)	No Data	All-weather	Asphaltic Concrete	6.7 m (22 ft)/ Good	No Data	No Data
East Range Road	28550490–35100660	1.90 km (1.18 mi)	No Data	Fair-weather	Dirt	4.6 m (15 ft)/ Good	No Data	No Data
Elm Road	27701480–24221127	.20 km (.14 mi)	No Data	Fair-weather	Dirt	10 m (34 ft)/ Good	No Data	No Data
Fifth Street	33801815–34401700	1.26 km (.78 mi)	No Data	All-weather	Asphaltic Concrete	7.3 m (24 ft)/ Excellent	No Data	No Data
Fourth Division Drive	32901540–32601150	4.50 km (2.76 mi)	No Data	All-weather	Asphaltic Concrete	7.6 m (25 ft)/ Good	No Data	No Data
Garfield Drive	34651675–35101685	.60 km (.34 mi)	No Data	All-weather	Asphaltic Concrete	10 m (33 ft)/ Excellent	No Data	No Data
Goodacres Road	37550950–45650730	7.70 km (4.80 mi)	No Data	All-weather, Fair-weather	Asphaltic Concrete Dirt	9.1 m (30 ft)/ 7.6 m (25 ft)/Good	No Data	No Data
Segment 1	37550950–37600930	1.00 km (.60 mi)	No Data	Fair-weather	Dirt	9.1 m (30 ft)/ Good	No Data	No Data
Segment 2	37600930–42400865	3.50 km (2.14 mi)	No Data	Fair-weather	Dirt	9.1 m (30 ft)/ Good	No Data	No Data
Segment 3	42400865–45650730	3.30 km (2.06 mi)	No Data	All-weather	Asphaltic Concrete	7.6 m (25 ft)/ Good	No Data	No Data
Gow Road	33300535–34010535	.63 km (.39 mi)	No Data	Fair-weather	Dirt	4.6 m (15 ft)/ Good	No Data	No Data
Hanna Drive	28401490–28651540	.63 km (.39 mi)	No Data	All-weather	Asphaltic Concrete	6.7 m (22 ft)/ Good	No Data	No Data
Harts Lake Loop Road	42371590–42430465	9.40 km (5.84 mi)	No Data	All-weather, Fair-weather	Asphaltic Concrete Dirt	7.6 m (25 ft)/ 4.6 m (15 ft)/Good	No Data	No Data
Segment 1	42371590–42401280	1.70 km (1.08 mi)	No Data	Fair-weather	Dirt	4.6 m (15 ft)/ Good	No Data	No Data
Segment 2	42401250–42430465	7.65 km (4.75 mi)	No Data	All-weather	Asphaltic Concrete	7.6 m (25 ft)/ Good	No Data	No Data
Hubbard Road	21209410–23109685	2.55 km (1.58 mi)	No Data	Fair-weather	Dirt	7.6 m (25 ft)/ Good	No Data	No Data
Segment 1	21209410–21509450	.40 km (.25 mi)	No Data	Fair-weather	Dirt	7.6 m (25 ft)/ Good	No Data	No Data
Segment 2	21739490–23109685	2.15 km (1.33 mi)	No Data	Fair-weather	Dirt	7.6 m (25 ft)/ Good	No Data	No Data
I Street	30202050–28731645	5.72 km (3.55 mi)	No Data	All-weather	Asphaltic Concrete	6.7 m (22 ft)/ Good	No Data	No Data
Jackson Avenue	32901535–34351695	2.54 km (1.57 mi)	No Data	All-weather	Asphaltic Concrete	7.3 m (24 ft)/ Excellent	No Data	No Data
Johnson Road	22000110–19959580	7.50 km (4.66 mi)	No Data	Fair-weather	Dirt	7.6 m (25 ft)/ Good	No Data	No Data
Kaufman Avenue	28401490–28851500	.64 km (.39 mi)	No Data	All-weather	Asphaltic Concrete	10.7 m (35 ft)/ Good	No Data	No Data
K. D. Road	34801020–35951000	.95 km (.59 mi)	No Data	Fair-weather	Dirt	4.5 m (15 ft)/ Good	No Data	No Data
Lewis Drive	29251455–29251560	1.27 km (.79 mi)	No Data	All-weather	Asphaltic Concrete	9.1 m (30 ft)/ Good	No Data	No Data
Lewis Lake Road	32870525–31250225	4.44 km (2.76 mi)	No Data	Fair-weather	Dirt	4.6 m (15 ft)/ Good	No Data	No Data
Lincoln Street	34731626–35201635	.63 km (.39 mi)	No Data	All-weather	Asphaltic Concrete	11 m (36 ft)/ Good	No Data	No Data
Mitchel Road	42461270–43101267	.63 km (.39 mi)	No Data	All-weather	Asphaltic Concrete	6.7 m (22 ft)/ Good	No Data	No Data
Mounts Road	24801470–25011450	.55 km (.34 mi)	No Data	All-weather	Asphaltic Concrete	6.7 m (22 ft)/ Good	No Data	No Data
Nisqually Road	23151190–23201220	.25 km (.15 mi)	No Data	All-weather	Asphaltic Concrete	7.3 m (24 ft)/ Fair	No Data	No Data
Nisqually Bridge Road	26700345–28180363	1.90 km (1.18 mi)	No Data	Fair-weather	Dirt	7.6 m (25 ft)/ Good	No Data	No Data
Nisqually Indian Reser. Rd.	23500620–23500590	.31 km (.19 mi)	No Data	Fair-weather	Dirt	4.6 m (15 ft)/ Good	No Data	No Data
North A Road	34451800–34751835	.50 km (.31 mi)	No Data	Fair-weather	Asphaltic Concrete	6.7 m (22 ft)/ Excellent	No Data	No Data
North Gate Road	30752045–32852130	2.54 km (1.58 mi)	No Data	All-weather	Asphaltic Concrete	6.7 m (22 ft)/ Good	No Data	No Data
Old Pacific Highway	25091419–23201220	2.54 km (1.58 mi)	No Data	All-weather	Asphaltic Concrete	6.7 m (22 ft)/ Good	No Data	No Data
Patrol Road	37501473–35251170	5.08 km (3.15 mi)	No Data	Fair-weather	Dirt	4.6 m (15 ft)/ Good	No Data	No Data
Pendleton Avenue	28721600–32551520	3.81 km (2.36 mi)	No Data	All-weather	Asphaltic Concrete	10.9 m (36 ft)/ Good	No Data	No Data
Perry Avenue	33801815–35601700	2.54 km (1.58 mi)	No Data	All-weather	Asphaltic Concrete	6.7 m (22 ft)/ Excellent	No Data	No Data
Pincus Road	35800890–38550475	5.71 km (3.55 mi)	No Data	Fair-weather	Dirt	4.6 m (15 ft)/ Good	No Data	No Data
Pittit Road	42500465–44000465	1.55 km (.96 mi)	No Data	All-weather	Asphaltic Concrete	7.6 m (25 ft)/ Good	No Data	No Data
Pole Line Road	44001260–45000720	4.44 km (2.76 mi)	No Data	All-weather	Asphaltic Concrete	8.2 m (27 ft)/ Good	No Data	No Data
Railroad Avenue	29231467–31501300	2.85 km (1.77 mi)	No Data	All-weather	Asphaltic Concrete	7.6 m (25 ft)/ Good	No Data	No Data
Rainer Drive	34301865–36301675	2.54 km (1.58 mi)	No Data	All-weather	Asphaltic Concrete	7.3 m (24 ft)/ Excellent	No Data	No Data
Rainer Road	16809970–21209410	7.30 km (4.53 mi)	No Data	All-weather	Asphaltic Concrete	7.6 m (25 ft)/ Good	No Data	No Data
Range/Patrol Road	32751181–36151085	3.81 km (2.36 mi)	No Data	Fair-weather	Dirt	6.7 m (22 ft)/ Good	No Data	No Data
Rathburn Road	24600000–24609990	3.45 km (2.14 mi)	No Data	Fair-weather	Dirt	7.6 m (25 ft)/ Good	No Data	No Data
Segment 1	24600000–25500060	1.25 km (.77 mi)	No Data	Fair-weather	Dirt	7.6 m (25 ft)/ Good	No Data	No Data

FORT LEWIS (continued)

TABLE J-1, ROADS (continued)

ROUTE NAME[1]	GRID COORDINATES FROM TO	LENGTH OF ROAD	MILITARY LOAD CLASSIFICATION	ROUTE TYPE	SURFACE CONSTRUCTION MATERIAL	SURFACE WIDTH/ CONDITION	SHOULDERS CONSTRUCTION MATERIAL	SHOULDERS WIDTH/ CONDITION
Segment 2	24509920–26409990	2.20 km (1.36 mi)	No Data	Fair-weather	Dirt	7.6 m (25 ft)/ Good	No Data	No Data
Second Division Drive	31301240–32701550	3.81 km (2.36 mi)	No Data	All-weather	Asphaltic Concrete	7.3 m (24 ft)/ Good	No Data	No Data
Solo Point Road	27501990–27501910	.62 km (.38 mi)	No Data	Fair-weather	Dirt	4.6 m (15 ft)/ Good	No Data	No Data
South Drive	28551795–30501873	1.90 km (1.18 mi)	No Data	All-weather	Asphaltic Concrete	6.7 m (22 ft)/ Excellent	No Data	No Data
Spurgeon Creek Road	17909970–18009840	1.20 km (.74 mi)	No Data	All-weather	Asphaltic Concrete	7.6 m (25 ft)/ Good	No Data	No Data
State Route 5	23200565–23950585	.63 km (.39 mi)	No Data	All-weather	Asphaltic Concrete	10.6 m (35 ft)/ Good	No Data	No Data
State Route 510	23650615–27200200	5.00 km (3.10 mi)	No Data	All-weather	Asphaltic Concrete	6.7 m (22 ft)/ Good	No Data	No Data
Segment 1	23650615–24700550	1.90 km (1.18 mi)	No Data	All-weather	Asphaltic Concrete	6.7 m (22 ft)/ Good	No Data	No Data
Segment 2	26000465–27200200	3.10 km (1.92 mi)	No Data	All-weather	Asphaltic Concrete	6.7 m (22 ft)/ Good	No Data	No Data
Steedman Road	15159870–16809955	2.54 km (1.58 mi)	No Data	All-weather	Asphaltic Concrete	10.6 m (35 ft)/ Good	No Data	No Data
Steilacoom Road	28731740–30202275	4.80 km (2.98 mi)	No Data	All-weather	Asphaltic Concrete	6.7 m (22 ft)/ Good	No Data	No Data
Story Road	25000940–32150895	7.61 km (4.73 mi)	No Data	Fair-weather	Dirt	11 m (36 ft)/ Good	No Data	No Data
Stryker Avenue	28851497–31951260	3.81 km (2.36 mi)	No Data	All-weather	Asphaltic Concrete	6.7 m (22 ft)/ Good	No Data	No Data
Transmission Line Road	31601660–40601510	8.90 km (5.53 mi)	No Data	Fair-weather	Dirt	7.6 m (25 ft)/ Good	No Data	No Data
Union Road	24300560–26800304	8.25 km (5.12 mi)	No Data	Fair-weather	Dirt	7.6 m (25 ft)/ Good	No Data	No Data
Veteran Drive	30701867–32902090	3.32 km (2.06 mi)	No Data	All-weather	Asphaltic Concrete	7.6 m (25 ft)/ Good	No Data	No Data
Walbdrick Road	17609890–18309490	4.90 km (3.04 mi)	No Data	Fair-weather	Dirt	7.6 m (25 ft)/ Good	No Data	No Data
West Range Road	25801460–32850650	15.24 km (9.46 mi)	No Data	Fair-weather	Dirt	5.3 m (18 ft)/ Good	No Data	No Data
Wilson Avenue	34351695–34721625	.95 km (.59 mi)	No Data	All-weather	Asphaltic Concrete	8.5 m (28 ft)/ Good	No Data	No Data
Xmas Tree Road	35300800–35270967	1.35 km (.83 mi)	No Data	Fair-weather	Dirt	4.6 m (15 ft)/ Good	No Data	No Data
2nd Division Range Road	28530500–31501295	9.52 km (5.91 mi)	No Data	All-weather, Fair-weather	Asphaltic Concrete Dirt	7.3 m (24 ft)/ 6.7 m (22 ft)/ Good	No Data	No Data
Segment 1	28530500–31001120	7.61 km (4.73 mi)	No Data	Fair-weather	Dirt	6.7 m (22 ft)/ Good	No Data	No Data
Segment 2	31001120–31501295	1.90 km (1.18 mi)	No Data	All-weather	Asphaltic Concrete	7.3 m (24 ft)/ Good	No Data	No Data
2nd Engineer Battalion Road	30802050–30802280	2.20 km (1.36 mi)	No Data	Fair-weather	Dirt	4.6 m (15)/ Good	No Data	No Data
3rd Division Road	28200367–29700387	1.58 km (.98 mi)	No Data	Fair-weather	Dirt	6.7 m (22 ft)/ Good	No Data	No Data
5th Engineer Battalion Road	30902120–32002150	1.10 km (.68 mi)	No Data	Fair-weather	Dirt	4.6 m (15 ft)/ Good	No Data	No Data
6th Engineer Battalion Road	31102110–32002120	.80 km (.49 mi)	No Data	Fair-weather	Dirt	4.6 m (15 ft)/ Good	No Data	No Data
6th Division Road	26801325–28550960	6.35 km (3.94 mi)	No Data	Fair-weather	Dirt	6 m (20 ft)/ Good	No Data	No Data
7th Infantry Regiment Road	35030645–37991799	10.50 km (6.52 mi)	No Data	Fair-weather	Dirt	7.6 m (25 ft) Good	No Data	No Data
8th Street	28951910–29901820	1.15 km (.71 mi)	No Data	All-weather	Asphaltic Concrete	7.6 m (25 ft)/ Good	No Data	No Data
9th Engineer Battalion Road	27501990–28702000	1.35 km (.83 mi)	No Data	Fair-weather	Dirt	4.6 m (15 ft)/ Good	No Data	No Data
9th Infantry Road	27901390–29121260	2.54 km (1.58 mi)	No Data	Fair-weather	Dirt	10 m (33 ft)/ Good	No Data	No Data
10th F. A. Battalion Road	34841020–32900700	3.90 km (2.42 mi)	No Data	Fair-weather	Dirt	7.6 m (25 ft)/ Good	No Data	No Data
15th F. A. Battalion Road	28131104–29251070	1.90 km (1.18 mi)	No Data	Fair-weather	Dirt	7.6 m (25 ft)/ Good	No Data	No Data
15th Infantry Regiment Road	38151623–36950922	7.62 km (4.73 mi)	No Data	Fair-weather	Dirt	9.1 m (30 ft)/ Good	No Data	No Data
23rd Division Road	26741110–27601257	1.90 km (1.18 mi)	No Data	Fair-weather	Dirt	4.6 m (15 ft)/ Good	No Data	No Data
30th Infantry Regiment Road	40751500–40800475	11.43 km (7.10 mi)	No Data	Fair-weather	Dirt	7.6 m (25 ft)/ Good	No Data	No Data
31st AAA Brigade Road	26400405–23309817	5.08 km (3.15 mi)	No Data	Fair-weather	Dirt	7.6 m (25 ft)/ Good	No Data	No Data
32nd Division Drive	29201799–30802050	3.33 km (2.06 mi)	No Data	All-weather	Asphaltic Concrete	6.7 m (22 ft)/ Good	No Data	No Data
Segment 1	29201799–29201880	.95 km (.59 mi)	No Data	All-weather	Asphaltic Concrete	6.7 m (22 ft)/ Good	No Data	No Data
Segment 2	29201880–30802050	2.38 km (1.47 mi)	No Data	All-weather	Asphaltic Concrete	6.7 m (22 ft)/ Good	No Data	No Data
33rd Division Road	32301190–33530800	6.98 km (4.34 mi)	No Data	Fair-weather	Dirt	11 m (36 ft)/ Good	No Data	No Data
35th Engineer Battalion Road	28401890–28521889	.32 km (.19 mi)	No Data	All-weather	Asphaltic Concrete	6.1 m (20 ft)/ Good	No Data	No Data
38th Division Road	31091235–31301225	.28 km (.17 mi)	No Data	Fair-weather	Dirt	7.6 m (25 ft)/ Good	No Data	No Data
38th Infantry Road	27901210–29001200	1.27 km (.78 mi)	No Data	Fair-weather	Dirt	7.6 m (25 ft)/ Good	No Data	No Data
40th Division Road	25881423–27150895	6.98 km (4.34 mi)	No Data	Fair-weather	Dirt	4.6 m (15 ft)/ Good	No Data	No Data
41st Division Drive	29801940–31011680	2.85 km (1.77 mi)	No Data	All-weather	Asphaltic Concrete	7.2 m (24 ft)/ Good	No Data	No Data
41st Division Drive South	30951410–31401660	2.54 km (1.58 mi)	No Data	All-weather	Asphaltic Concrete	(See Segments)	No Data	No Data
Segment 1	30951410–31001480	1.04 km (.65 mi)	No Data	All-weather	Asphaltic Concrete	7.6 m (25 ft)/ Good	No Data	No Data
Segment 2	31001480–31401660	1.49 km (.92 mi)	No Data	All-weather	Asphaltic Concrete	15.8 m (52 ft)/ Good	No Data	No Data
44th Division Road	29991410–30350975	4.44 km (2.76 mi)	No Data	Fair-weather	Dirt	8.7 m (29 ft)/	No Data	No Data
47th QM Road	24150570–26300320	1.92 km (1.19 mi)	No Data	Fair-weather	Dirt	7.6 m (25 ft)/ Good	No Data	No Data
Segment 1	24150570–24750530	.62 km (.38 mi)	No Data	Fair-weather	Dirt	7.6 m (25 ft)/ Good	No Data	No Data
Segment 2	25000470–26300320	1.30 km (.80 mi)	No Data	Fair-weather	Dirt	7.6 m (25 ft)/ Good	No Data	No Data
56th QM Road	24200245–26970228	3.81 km (2.36 mi)	No Data	Fair-weather	Dirt	4.6 m (15 ft)/ Good	No Data	No Data
60th Signal Battalion Road	22200070–25500120	4.27 km (2.65 mi)	No Data	Fair-weather	Dirt	6 m (20 ft)/ Good	No Data	No Data
Segment 1	22200070–24700000	2.85 km (1.77 mi)	No Data	Fair-weather	Dirt	6 m (20 ft)/ Good	No Data	No Data
Segment 2	24600020–25500120	1.42 km (.88 mi)	No Data	Fair-weather	Dirt	6 m (20 ft)/ Good	No Data	No Data
91st Division Road	29501099–31301320	3.80 km (2.36 mi)	No Data	Fair-weather	Dirt	4.6 m (15 ft)/ Good	No Data	No Data
91st Squadron Road	41631587–42211500	1.25 km (.77 mi)	No Data	Fair-weather	Dirt	6.1 m (20 ft)/ Good	No Data	No Data
96th Division Road	24701040–27901395	5.71 km (3.55 mi)	No Data	Fair-weather	Dirt	10 m (33 ft)/ Good	No Data	No Data
99th A.T. Battalion Road	28700860–29901010	1.90 km (1.74 mi)	No Data	Fair-weather	Dirt	4.6 m (15 ft)/ Good	No Data	No Data
116th F.A. Brigade Road	22909695–20509490	3.10 km (1.92 mi)	No Data	Fair-weather	Dirt	4.6 m (15 ft)/ Good	No Data	No Data
116th Squadron Road	38051515–38101840	3.17 km (1.97 mi)	No Data	All-weather	Asphaltic Concrete	6.7 m (22 ft)/ Good	No Data	No Data
150th Street	34751835–34851915	.63 km (.39 mi)	No Data	Fair-weather	Asphaltic Concrete	6.7 m (22 ft)/ Good	No Data	No Data

FORT LEWIS (continued)

TABLE J-1, ROADS (continued)

ROUTE NAME[1]	GRID COORDINATES FROM TO	LENGTH OF ROAD	MILITARY LOAD CLASSIFICATION	ROUTE TYPE	SURFACE CONSTRUCTION MATERIAL	SURFACE WIDTH/ CONDITION	SHOULDERS CONSTRUCTION MATERIAL	SHOULDERS WIDTH/ CONDITION
166th F.A. Brigade Road	24600000–22909696	4.10 km (2.54 mi)	No Data	Fair-weather	Dirt	4.6 m (15 ft)/ Good	No Data	No Data
205th AAA Road	23060281–24600030	4.01 km (2.49 mi)	No Data	Fair-weather	Dirt	4.6 m (15 ft)/ Good	No Data	No Data
231st Engineer Battalion Road	30152150–32002200	2.22 km (1.37 mi)	No Data	Fair-weather	Dirt	4.6 m (15 ft)/ Good	No Data	No Data
346th F.A. Road	29670392–32500385	2.75 km (1.70 mi)	No Data	Fair-weather	Dirt	10.6 m (35 ft)/ Good	No Data	No Data
347th F.A. Road	31240500–31300230	2.54 km (1.58 mi)	No Data	Fair-weather	Dirt	7.6 m (25 ft)/ Good	No Data	No Data
348th F.A. Road	27920460–27950375	.63 km (.39 mi)	No Data	Fair-weather	Dirt	7.6 m (25 ft)/ Good	No Data	No Data
361st Infantry Road	24301240–25301140	1.40 km (.86 mi)	No Data	Fair-weather	Dirt	4.6 m (15 ft)/ Good	No Data	No Data
362nd Infantry Road	24701340–25201320	.95 km (.59 mi)	No Data	Fair-weather	Dirt	4.6 m (15 ft)/ Good	No Data	No Data
363rd Infantry Road	25351329–26731345	1.90 km (1.18 mi)	No Data	Fair-weather	Dirt	5.7 m (19 ft)/ Good	No Data	No Data
703rd A.T. Battalion Road	30451100–30500800	3.80 km (2.36 mi)	No Data	Fair-weather	Dirt	4.6 m (15 ft)/ Good	No Data	No Data

ADDITIONAL INSTALLATION ROUTES (Unnamed)

CATEGORY	TOTAL LENGTH (Approximate)
Tank Trails	95 Km (59 mi)
Improved Dirt Roads	103 Km (64 mi)
Unimproved Dirt Roads	307 Km (191 mi)

[1]Names listed alphabetically.

NOTE: Eight digit grid reference coordinates were used to increase the accuracy of some locations.

TABLE J-2, ROAD BRIDGES

MAP NUMBER AND/ OR NAME	ROUTE DESIGNATION	GRID COORDINATES	FEATURE CROSSED	MILITARY LOAD[1] CLASSIFICATION	DIMENSIONS LENGTH	DIMENSIONS WIDTH	CLEARANCE HORIZONTAL	CLEARANCE VERTICAL	TYPE/CONSTRUCTION MATERIAL	CONDITION
1	No Data	396087	Muck Creek	50 Tons	12 m (40 ft)	5.2 m (17 ft)	3 m (10 ft)	Unlimited	Deck/Construction material; Combination Concrete substructure, steel stringer, wood deck.	Good
2	Hart Lake Loop Road	424080	Muck Creek	No Data	9.7 m (32 ft)	7.3 m (24 ft)	4.6 m (15 ft)	Unlimited	Deck/Construction material; Concrete deck.	Good
3	No Data	356066	Muck Creek	50 Tons	12 m (40 ft)	7.6 m (25 ft)	6.8 m (23 ft)	Unlimited	Deck/Construction material; Combination Concrete substructure, steel stringer, concrete deck.	Good
4	No Data	303054	Muck Creek	50 Tons	13m (42 ft)	7.3 m (24 ft)	5.7 m (19 ft)	Unlimited	Deck/Construction material; Combination Concrete substructure, steel stringer, concrete deck.	Good
5	No Data	283048	Muck Creek	50 Tons	12 m (40 ft)	5.2 m (17 ft)	3.6 m (12 ft)	Unlimited	Deck/Construction material; Combination Concrete substructure, steel stringer, wood deck.	Good
6, Nisqually River Bridge	Nisqually	281037	Nisqually River	50 Tons	77 m (252 ft)	4.6 m (15 ft)	3.3 m (11 ft)	Unlimited	Deck/Construction material; Combination Concrete substructure, steel stringer approach spans, steel truss center spans, treated wood deck.	Good
7	No Data	292172	Hammer Marsh Drainage Canal	No Data	19 m (62 ft)	5 m (16 ft)	4.2 m (14 ft)	Unlimited	Deck/Construction material; untreated wood trestle.	Good
8	No Data	291175	Sequalitchew Creek	No Data	15.2 m (50 ft)	8 m (26 ft)	7 m (22 ft)	Unlimited	Deck/Construction material; Wood.	Good

[1]Washington State Highway load classification, not converted to military load classification.

TABLE J-3, TUNNELS

MAP NUMBER	GRID COORDINATES	DIMENSIONS LENGTH	DIMENSIONS WIDTH	OVERHEAD CLEARANCE	APPROACH CONDITION	CONSTRUCTION MATERIAL
1	292156	35 m (114 ft)	Road width 7.3 m (24 ft) Overall width 9.1 m (30 ft)	3.4 m (11 ft)	Easy	Concrete
2	292157	5 m (17 ft)	Road width 7.3 m (24 ft) Overall width 9.1 m (30 ft)	3.4 m (11 ft)	Easy	Concrete

TABLE J-4, RAILROADS

MAP NUMBER AND/OR NAME	GRID COORDINATES	LENGTH OF TRACK OR TRACK SEGMENT	OWNERSHIP AND CONDITION	TRACK AND BED CHARACTERISTICS	CROSS-OVERS (GRID COORDINATES)	SIDINGS (GRID COORDINATES)	WYES (GRID COORDINATES)	TRAFFIC VOLUME AND CAPACITY	SERVICE FACILITIES (GRID COORDINATES)	REMARKS
Line 1	From 306166 to 286177	3143 m (10,312 ft)	US Government owned. Good condition.	Gage: Standard gage. Number of tracks: Single. Weight of rails: 41 kgs/m (90 lbs/yd). Maximum degree of curvature: 8°. Maximum grade: 1%. Ballast material: Crushed rock and gravel.	None	From 305169 to 300170: 693 m (2275 ft) long.	291176 Length of track: 697 m (2288 ft).	Approximately 75-200 cars per month.	None	Line 1 is connected to the Burlington Northern Rail Line, which is the main railroad to the port of Tacoma. For further information concerning ports, refer to table on Ports.
Team Yard 1										
Segment A	From 286177 to 286189	968 m (3175 ft)	Same as Line 1	Same as Line 1	None	None	None	Same as Line 1	Engine house: 286179	
Segment B	From 286180 to 286189	857 m (2812 ft)	Same as Line 1	Same as Line 1	None	None	None	Same as Line 1	None	
Segment C	From 286179 to 286189	811 m (2662 ft)	Same as Line 1	Same as Line 1	None	None	None	Same as Line 1	None	

FORT LEWIS (continued)

TABLE J-4, RAILROADS (continued)

MAP NUMBER AND/OR NAME	GRID COORDINATES	LENGTH OF TRACK OR TRACK SEGMENT	OWNERSHIP AND CONDITION	TRACK AND BED CHARACTERISTICS	CROSS-OVERS (GRID COORDINATES)	SIDINGS (GRID COORDINATES)	WYES (GRID COORDINATES)	TRAFFIC VOLUME AND CAPACITY	SERVICE FACILITIES (GRID COORDINATES)	REMARKS
Segment D	From 286177 to 286188	846 m (2775 ft)	Same as Line 1	Same as Line 1	286187	None	None	Same as Line 1	None	
Segment E	From 286179 to 286188	640 m (2100 ft)	Same as Line 1	Same as Line 1	286187	None	None	Same as Line 1	None	
Total length of track on Line 1: 8.66 km (5.4 mi).										
Line 2	From 276150 to 311135	4016 m (13,175 ft)	US Government owned. Good condition.	Gage: Standard gage. Number of tracks: Single. Weight of rails: Varies from 34 to 41 kgs/m (75 to 90 lbs/yd). Maximum degree of curvature: 8°. Maximum grade: 1%. Ballast material: Crushed rock and gravel.	None	From 299142 to 279150: 2225 m (7300 ft) long; from 308137 to 306138: 183 m (600 ft) long; from 308137 to 306138: 251 m (825 ft) long; from 301140 to 297142: 408 m (1338 ft) long; from 300141 to 295143: 671 m (2200 ft) long; from 299142 to 296143: 160 m (525 ft) long; from 287149 to 286149: 179 m (588 ft) long; from 287150 to 284149: 446 m (1462 ft) long; from 284149 to 281151: 305 m (1000 ft) long; from 282145 to 280149: 678 m (2225 ft) long; from 284148 to 280149: 396 m (1300 ft) long; from 280151 to 277150: 351 m (1150 ft) long.	277150 Length of track: 766 m (2512 ft).	Approximately 75–200 cars per month.	Engine house: 286149	Line 2 is connected to the Burlington Northern Rail Line, which is the main railroad to the port of Tacoma. For further information concerning ports, refer to table on Ports.
Team Yard 2										
Segment A	From 292153 to 285149	556 m (1825 ft)	Same as Line 2	Same as Line 2	None	None	None	Same as Line 2	None	
Segment B	From 292153 to 285149	556 m (1825 ft)	Same as Line 2	Same as Line 2	None	None	None	Same as Line 2	None	
Total length of track on Line 2: 12.1 km (7.6 mi).										
Line 3	From 370174 to 379179	2438 m (8000 ft)	US Government owned. Good condition.	Gage: Standard gage. Number of tracks: Multiple. Weight of rails: Varies from 34 to 41 kgs/m (75 to 90 lbs/yd). Spacing of multiple track: 3 m (10 ft). Maximum degree of curvature: 8°. Maximum grade: 1%. Ballast material: Crushed rock and gravel.	376176	None	None	Approximately 75–200 cars per month.	None	Line 3 is connected to the Burlington Northern Rail Line, which is the main railroad to the port of Tacoma. For further information concerning ports, refer to table on Ports.
Team Yard 3										
Segment A	From 355177 to 365171	1261 m (4137 ft)	Same as Line 3	Same as Line 3	355177, 359173	None	None	Same as Line 3	None	
Segment B	From 353178 to 361171	1113 m (3650 ft)	Same as Line 3	Same as Line 3	Same as Segment A	None	None	Same as Line 3	None	
Segment C	From 354176 to 363171	1189 m (3900 ft)	Same as Line 3	Same as Line 3	359173	None	None	Same as Line 3	None	
Segment D	From 354176 to 361170	823 m (2700 ft)	Same as Line 3	Same as Line 3	Same as Segment C	None	None	Same as Line 3	None	
Segment E	From 347181 to 360170	1581 m (5187 ft)	Same as Line 3	Same as Line 3	349179, 352177 & 356174	None	None	Same as Line 3	Engine house: 353177	
Segment F	From 347181 to 362170	2076 m (6812 ft)	Same as Line 3	Same as Line 3	Same as Segment E	None	None	Same as Line 3	None	
Segment G	From 349177 to 357170	1090 m (3575 ft)	Same as Line 3	Same as Line 3	None	None	None	Same as Line 3	None	
Segment H	From 349177 to 358169	1219 m (4000 ft)	Same as Line 3	Same as Line 3	353174, 354173	None	358169 Length of track: 777 m (2550 ft).	Same as Line 3	None	
Segment I	From 349177 to 357170	1128 m (3700 ft)	Same as Line 3	Same as Line 3	Same as Segment H	None	None	Same as Line 3	None	
Segment J	From 348175 to 360169	1478 m (4850 ft)	Same as Line 3	Same as Line 3	None	From 351173 to 354169: 629 m (2062 ft) long.	None	Same as Line 3	None	
Segment K	From 351168 to 353165	320 m (1050 ft)	Same as Line 3	Same as Line 3	None	None	None	Same as Line 3	None	
Segment L	From 351169 to 359168	1303 m (4275 ft)	Same as Line 3	Same as Line 3	None	None	None	Same as Line 3	None	
Total length of track on Line 3: 18.43 km (11.45 mi).										

TABLE J-5, RAILROAD BRIDGES

MAP NUMBER	GRID COORDINATES	FEATURE CROSSED	NUMBER OF TRACKS	ROADBED WIDTH	CLEARANCE HORIZONTAL	CLEARANCE VERTICAL	DECK MATERIAL	OVERALL LENGTH	TYPE OF STRUCTURE
1	292176	Stream	Single	3.8 m (13 ft)	10.6 m (35 ft)	Unlimited	Wood	15 m (50 ft)	Trestle

TABLE J-6, AIRFIELDS/AIRSTRIPS

MAP NUMBER AND/OR NAME; GRID COORDINATES; TYPE; AND CLASSIFICATION	ELEVATION AND STATUS	RUNWAY DESCRIPTION	TAXIWAY, PARKING APRON, AND HARDSTAND AREA DESCRIPTION	BUILDING DESCRIPTION	POL FACILITIES	NAVIGATIONAL AIDS	REMARKS
1, Gray Army Airfield; 319141; Airfield; Army.	Elevation: 91 m (300 ft). Status: Operational.	Runway: Dimensions: 1866.9 m (6125 ft) long; 45.7 m (150 ft) wide. Azimuth: 160°-340°. Weight bearing capacity: S-65, T-200, ST-175, TT-330.[1] Surface material and condition: Asphalt surface in good condition.	Taxiways: Two with lengths and widths of 1088 × 15 m (3570 × 50 ft) and 1585 × 18 m (5200 × 60 ft). Maximum weight bearing capacity same as runway. Parking Apron and Hardstand Areas: Four asphalt surface parking areas and one grass surface parking area. Total area 480,684 m^2 (1,577,049 ft^2). Maximum weight bearing capacity same as runway.	Hangars: Eight Dimensions: 39.6 × 39.6 m (130 × 130 ft); 48.7 × 42.6 m (160 × 140 ft); 48.7 × 42.6 m (160 × 140 ft); 39.6 × 33.5 m (130 × 110 ft); 60.9 × 57.9 m (200 × 190 ft); 39.6 × 33.5 m (130 × 110 ft); 42.6 × 36.5 m (140 × 120 ft); 54.8 × 42.6 m (180 × 140 ft). Construction material: Concrete with steel frame.	Types of fuel: US Aviation Fuel (Mil Specs) 115/145 grade; JP-4; grade 1065 (dispersant), reciprocating engine oil (Mil-L-22851 type 111); grade 1100, (dispersant), reciprocating engine oil (Mil-L-22851 type 11); no grade, Mil-L-7808 (synthetic base), turboprop and turboshaft engines. Storage and Dispensing Facilities: Storage underground 100,000 gal 115/145, 100,000 gal JP-4 Rolling	Control Tower: Height 23 m (75 ft). Communications: FSS Seattle Sea-DL-NOTAM Sea; Tacoma App Control; Tacoma Dep Control; Clearance Delivery. Instrument Landing System: Radio aids to Navigation, Radar. Lighting: Rotating light (rotating beacon); high intensity runway lights.	Heliport located at airfield (see Helicopter Landing Zones). Aerodrome is only partially covered by the USAF NOTAM system and maintains a military NOTAM file. (For complete aerodrome information, civil NOTAMS must also be consulted).

TABLE J-6, AIRFIELDS/AIRSTRIPS (continued)

MAP NUMBER AND/OR NAME; GRID COORDINATES; TYPE; AND CLASSIFICATION	ELEVATION AND STATUS	RUNWAY DESCRIPTION	TAXIWAY, PARKING APRON, AND HARDSTAND AREA DESCRIPTION	BUILDING DESCRIPTION	POL FACILITIES	NAVIGATIONAL AIDS	REMARKS
					Stock tank truck 115/145 4800 gal, 9600 gal JP-4 hydro system 115/145 for Helicopters Refueling system truck JP-4. Off-base storage is McChord Air Force Base. Delivered by truck from McChord to Gray.		
2, Airstrip No. 7; 412087; Airstrip; Army.	Elevation: 119 m (390 ft). Status: Operational.	Runway: Dimensions: 539 m (1768 ft) long; 23 m (75 ft) wide. Azimuth: 067°-247°. Surface material and condition: Grass surface in good condition.	None	None	None	None	None
3, Airstrip No. 8; 421076; Airstrip; Army.	Elevation: 119 m (390 ft). Status: Operational.	Runway: Dimensions: Approximately 425 m (1394 ft) long; 75 m (246 ft) wide. Azimuth: 030°-210°. Surface material and condition: Grass surface in good condition.	None	None	None	None	None
4, 348087; Airstrip; Army.	Elevation: 96 m (315 ft). Status: Operational.	Runway: Dimensions: 476 m (1562 ft) long; 23 m (75 ft) wide. Azimuth: 045°-225°. Surface material and condition: Grass surface in good condition.	None	None	None	None	None
5, 332078; Airstrip; Army.	Elevation: 98 m (320 ft). Status: Operational.	Runway: Dimensions: Approximately 360 m (1181 ft) long; 70 m (230 ft) wide. Azimuth: 066°-246°. Surface material and condition: Grass surface in good condition.	None	None	None	None	None
6, Airstrip No. 9; 338060; Airstrip; Army.	Elevation: 96 m (315 ft). Status: Operational.	Runway: Dimensions: 507 m (1662 ft) long; 23 m (75 ft) wide. Azimuth: 004°-184°. Surface material and condition: Grass surface in good condition.	None	None	None	None	None
7, Airstrip No. 12; 311042; Airstrip; Army.	Elevation: 91 m (300 ft). Status: Operational.	Runway: Dimensions: 437 m (1433 ft) long; 23 m (75 ft) wide. Azimuth: 160°-340°. Surface material and condition: Grass surface in good condition.	None	None	None	None	None
8, Airstrip No. 11; 307037; Airstrip; Army.	Elevation: 91 m (300 ft). Status: Operational.	Runway: Dimensions: 514 m (1688 ft) long; 23 m (75 ft) wide. Azimuth: 049°-229°. Surface material and condition: Grass surface in good condition.	None	None	None	None	None
9, Airstrip No. 15; 215950; Airstrip; Army.	Elevation: 142 m (465 ft). Status: Operational.	Runway: Dimensions: 892 m (2925 ft) long; 23 m (75 ft) wide. Azimuth: 178°-358°. Surface material and condition: Grass surface in good condition.	None	None	None	None	Road crosses landing strip.
10, Airstrip No. 14; 203970; Airstrip; Army.	Elevation: 124 m (407 ft). Status: Operational.	Runway: Dimensions: 282 m (925 ft) long; 23 m (75 ft) wide. Azimuth: 010°-190°. Surface material and condition: Grass surface in good condition.	None	None	None	None	None
11, Airstrip No. 13; 173983; Airstrip; Army.	Elevation: 91 m (300 ft). Status: Operational.	Runway: Dimensions: 305 m (1000 ft) long; 23 m (75 ft) wide. Azimuth: 173°-353°. Surface material and condition: Grass surface in good condition.	None	None	None	None	None
12, Airstrip No. 10; 264034; Airstrip; Army.	Elevation: 101 m (330 ft). Status: Operational.	Runway: Dimensions: 300 m (984 ft) long; 30 m (98 ft) wide. Azimuth: 148°-328°. Surface material and condition: Grass surface in good condition.	None	None	None	None	None
13, Airstrip No. 4; 251091; Airstrip; Army.	Elevation: 61 m (200 ft). Status: Operational.	Runway: Dimensions: 375 m (1230 ft) long; 19 m (63 ft) wide. Azimuth: 129°-309°. Surface material and condition: Grass surface in good condition.	None	None	None	None	None
14, 315212; Airstrip; Army.	Elevation: 61 m (200 ft). Status: Operational.	Runway: Dimensions: 674 m (2213 ft) long; 28 m (91 ft) wide. Azimuth: 055°-235°. Surface material and condition: Dirt surface in good condition.	None	None	None	None	Road crosses landing strip.

[1]Runway weight bearing capacity in pounds (gross weight of aircraft) is determined by adding 000 to figure following S, T, ST, TT, TDT. Runway weight bearing capacity given is for unlimited operations. Aircraft weight higher than given requires prior permission from aerodrome controlling authority.

S—Runway weight bearing capacity for aircraft with single-wheel type landing gear (C-47, F100).
T—Runway weight bearing capacity for aircraft with twin-wheel type landing gear (C-9A).
ST—Runway weight bearing capacity for aircraft with single-tandem landing gear (C-130).
TT—Runway weight bearing capacity for aircraft with twin-tandem type (includes quadricycle) landing gear (B-52, C-135).
TDT—Runway weight bearing capacity for aircraft with twin-delta tandem landing gear (C-5).

For further information, see DOD Flight Information Publication (enroute IFR-Supplement United States).

J. LINES OF COMMUNICATIONS (continued)

FORT LEWIS (continued)

TABLE J-7, PIPELINES

MAP NUMBER AND NAME	GRID COORDINATES	STATUS	OWNERSHIP/ MAINTENANCE RESPONSIBILITY	PIPELINE CHARACTERISTICS	TANK CROSSING SITES	REMARKS
1. Olympic Pipeline	Seg 1-A: From 326012 to 338039; Seg 1-B: From 365062 to 447125.	Operational	Olympic Pipeline Company	Diameter of Pipe: 35.5 cm (14 in.). Total Length of Pipeline: 19.75 km (12.27 mi). Types of Products: Pipeline carries various refined petroleum products. Rated Capacity: No data. Actual Throughput: No data.	No Data	There is a pumping station at Grid Coordinates 461101. Pipelines may interfere with maneuverability. All segments of pipelines are buried 48 inches below the surface of the ground.
2. Washington Natural Gas Co. Pipeline	Seg 2-A: From 233124 to 251141; Seg 2-B: From 251143 to 329211.	Operational	Northwest Pipeline Corporation	Diameter of Pipe: 10.1 cm (4 in.). Total Length of Pipeline: 8.58 km (5.33 mi). Types of Products: Pipeline carries various refined petroleum products. Rated Capacity: No data. Actual Throughput: No data.	No Data	
3. Northwest Pipeline	Seg 3-A: From 151990 to 164994; Seg 3-B: From 161997 to 205941; Seg 3-C: From 162997 to 206941; Seg 3-D: From 417047 to 463103.	Operational	Northwest Pipeline Corporation	Grid coordinates and diameter of pipes: From 417047 to 463103: 66 cm (26 in.); from 151990 to 164994: 25.4 cm (10 in.); from 161997 to 205941: 25.4 cm (10 in.); from 162997 to 206941: 25.4 cm (10 in.). Total Length of Pipeline: 27.36 km (17 mi). Types of Products: Pipeline carries natural gas. Rated Capacity: No data. Actual Throughput: No data.	No Data	There is a 15 m (50 ft) clearance on each side of the pipeline.

TABLE J-8, HELICOPTER LANDING ZONES

MAP NUMBER AND NAME	GRID COORDINATES	DIMENSIONS	AZIMUTH	ELEVATION	SURFACE DESCRIPTION	RESTRAINTS
1	295188	A circle 80 m (263 ft) in diameter	045°–225°	37 m (120 ft)	Grass	Landing zone has trees 15 m (50 ft) high on the east and west sides with 6 m (20 ft) trees on the south.
2	298192	95×95 m (312×312 ft)	045°–225°	37 m (120 ft)	Grass	Wires approximately 75 m (246 ft) north of landing zone and 150 m (492 ft) south. High embankment on the east side of pad. Trees 6 m (20 ft) high located on the east side of pick up area.
3	304199	A circle 80 m (263 ft) in diameter	045°–225°	37 m (120 ft)	Grass	None
4	343184	A circle 30 m (100 ft) in diameter	178°–358°	79 m (260 ft)	Concrete	None
5, Gray Army Airfield Helipad	324130	A circle 15 m (50 ft) in diameter	055°–235°	91 m (300 ft)	Asphalt/Concrete	None
6, Gray Army Airfield Helipad	324131	A circle 15 m (50 ft) in diameter	055°–235°	91 m (300 ft)	Grass	None
7, Gray Army Airfield Helipad	317143	A circle 34 m (113 ft) in diameter	140°–320°	91 m (300 ft)	Grass	None
8, Gray Army Airfield Helipad	315145	A circle 49 m (160 ft) in diameter	140°–320°	91 m (300 ft)	Grass	None
9, Gray Army Airfield helipad	318132	Cannot be determined	No Data	91 m (300 ft)	Grass	None
10	415077	Cannot be determined	No Data	119 m (390 ft)	Grass	None
11	414058	Cannot be determined	No Data	128 m (420 ft)	Grass	None
12	328034	Cannot be determined	030°–210°, 180°–360°	128 m 420 ft)	Grass	Helipad surrounded on all sides by trees 24 to 30 m (80 to 100 ft) in height.
13	321027	Cannot be determined	No Data	98 m (320 ft)	Grass	Scattered trees throughout landing zone.
14	309022	Cannot be determined	070°–250°, 055°–235°	61 m (200 ft)	Grass	Landing area has trees 27 m (90 ft) high on northern side and 6 to 15 m (20 to 50 ft) high on southern side, there are swamps in the northern area, this area also covered with fallen trees.
15	298028	Cannot be determined	No Data	85 m (280 ft)	Grass	Helipad surrounded on all sides by trees.
16	259998	Cannot be determined	020°–200°	113 m (370 ft)	Grass	Terminate northern approach. Southern area is sloped too badly to set aircraft down. A barbed wire fence presents an added hazard to southern section. Landing zone is surrounded by trees 24 to 27 m (80 to 90 ft) high.
17	247028	Cannot be determined	Approximately 014°–194°	122 m (400 ft)	Grass	Landing zone surrounded by trees 24 to 30 m (80 to 100 ft) high.
18	247048	Cannot be determined	010°–190°, 180°–360°	98 m (320 ft)	Grass	Only hazard to approach is unmarked power lines in northern end of landing zone. Dirt road runs north to south on the east side of landing area.
19	257081	Cannot be determined	170°–350°	61 m (200 ft)	Grass	Landing zone surrounded by trees approximately 18 m (60 ft) high on the north side. A steep ridge, 61 m (200 ft) high, runs from northwest to southeast just west of landing zone.
20	269089	Cannot be determined	170°–350°	49 m (160 ft)	Grass	Landing zone surrounded by trees approximately 18 m (60 ft) high on the north side. A close combat range and a mortar range also surround the landing area.
21	273088	Cannot be determined	170°–350°	49 m (160 ft)	Grass	Landing zone surrounded by trees approximately 18 m (60 ft) high on the north side. Close combat ranges are located directly south of landing area.
22	299077	Cannot be determined	No Data	104 m (340 ft)	Grass	None

FORT LEWIS (continued)

TABLE J-8, HELICOPTER LANDING ZONES (continued)

MAP NUMBER AND NAME	GRID COORDINATES	DIMENSIONS	AZIMUTH	ELEVATION	SURFACE DESCRIPTION	RESTRAINTS
23	303148	Cannot be determined	Approach azimuth 280°	107 m (350 ft)	Grass	Landing zone has trees 61 m (200 ft) high on the north edge. Telephone poles, lines, trees, and a school parking lot are located on the west side.
24	294152	Cannot be determined	090°–270°	107 m (350 ft)	Grass	None
25	294163	Cannot be determined	No Data	73 m (240 ft)	Grass	Landing zone has trees 24 m to 30 m (80 to 100 ft) high on the south edge.

TABLE J-9, DROP ZONES

MAP NUMBER AND NAME	GRID[1] COORDINATES	DIMENSIONS LENGTH	DIMENSIONS WIDTH	AZIMUTH	ELEVATION	SURFACE DESCRIPTION	RESTRAINTS	REMARKS
1. Merrill	SW 22429500 NW 22679670 NE 22329661 SE 23109492	564 m (1850 ft)	213 m (700 ft)	167°–347°	165 m (540 ft)	Terrain is predominantly flat with scattered trees approximately 27 m (90 ft) high. The slope in the drop zone ranges from 0–3%. No hazards are created by the numerous roads which are located within the drop zone.	None	Several roads throughout the area create a good transportation network in the vicinity of the drop zone. Type of drop zone: Air force personnel and heavy equipment.
2. Darby	SW 20509460 NW 21409542 NE 21839495 SE 20929411	411 m (1350 ft)	213 m (700 ft)	028°–208°	140 m (460 ft)	The drop zone is predominantly flat with slopes less than 3%.	None	Two roads in the area intersect major arteries. Type of drop zone: Air force personnel, heavy equipment and container delivery system.
3. Abrahms	SW 33390841 NW 33501000 NE 34260990 SE 34120832	2465 m (8088 ft)	1200 m (3937 ft)	164°–344°	98 m (320 ft)	Terrain is predominantly flat with slopes less than 3%. Scattered trees and roads throughout the drop zone are possible hazards.	None	Exit routes from the area consist of 33rd Division Road and 10th AT BN Road.
4. Rogers	SW 41080669 NW 41230842 NE 42210834 SE 42100660	579 m (1900 ft)	305 m (1000 ft)	164°–344°	199 m (390 ft)	The drop zone area is predominantly flat with slopes less than 8%. Possible hazards in the area are scattered trees, Muck Creek which runs through the drop zone along the northern boundary, and several roads.	None	The road network within the drop zone connects Harts Lake Loop Road which can be used as an exit road.
5. Dak To	357076	305 m (1000 ft)	152 m (500 ft)	No Data	100 m (330 ft)	Flat	None	DZ Inactive
6. Anzio	398051	244 m (800 ft)	183 m (600 ft)	No Data	125 m (410 ft)	Flat	None	DZ Inactive
7. Cisternia	414058	152 m (500 ft)	91 m (300 ft)	No Data	125 m (410 ft)	Flat	None	Helicopter landing zone in drop zone. DZ Inactive
8. Pointe de Hoc	284026	183 m (600 ft)	91 m (300 ft)	No Data	70 m (230 ft)	Flat	None	DZ Inactive
9. Myitkyina	246028	152 m (500 ft)	91 m (300 ft)	No Data	122 m (400 ft)	Flat	None	Helicopter landing zone in drop zone. DZ Inactive.
10. Yalu (tip)	223965	244 m (800 ft)	91 m (300 ft)	No Data	152 m (500 ft)	Flat	None	DZ Inactive
11. El Guettan	202966	274 m (900 ft)	152 m (500 ft)	No Data	125 m (410 ft)	Flat	None	DZ Inactive
12. Marion	300037	274 m (900 ft)	213 m (700 ft)	034°–214°	92 m (300 ft)	Flat	None	DZ Inactive
13. Cherry Hill	348088	732 m (2400 ft)	213 m (700 ft)	No Data	104 m (340 ft)	Flat	None	Type: Air force personnel and heavy equipment. DZ Inactive.

[1]Corner coordinates listed for active drop zones, center coordinates for inactive.

NOTE: Eight digit grid reference coordinates were used to increase the accuracy of some locations.

CAMP BONNEVILLE

Lines of Communications (LOC) at Camp Bonneville are depicted on the accompanying LOC map. Supportive information for LOC as shown on the graphic is provided in Tables J-10 through J-14 following this summary. ROADS: The existing road network is comprised of a hard surface road and improved and unimproved dirt roads. Together, they provide Camp Bonneville with approximately 64 kilometers (40 miles) of roads that have been depicted on the map to represent prevailing patterns and system connections. Of the 64 kilometers (40 miles) of roads approximately 2.54 kilometers (1.58 miles) of hard surface road has been depicted in the table. Because of their similar characteristics, the improved and unimproved dirt roads have been treated in groups rather than individually and are not shown in the table; these two categories comprise the majority of roads on Camp Bonneville. Data on military load classifications and road shoulder characteristics are not available. Refer to Table J-10, Roads, for individual road details. ROAD BRIDGES: There are three road bridges within the reservation boundaries, all having similar characteristics. Table J-11, Road Bridges, provides available details pertaining to each bridge. FORDS: Fords shown on the LOC map are limited to commonly used sites that serve as connection links in the road network. In terms of location, they are concentrated on Lackamas Creek in the southwest section of the reservation. Fording conditions are generally good from May through November. Individual ford characteristics are listed in Table B-9, under the Surface Drainage section of this analysis. AIRFIELDS/AIRSTRIPS: There is one airstrip on Camp Bonneville which is used for both fixed wing aircraft and helicopters. Refer to Table J-12, Airfields/Airstrips, for detailed information. PIPELINES: The pipeline network of Camp Bonneville consists of two government-owned segments, both of which carry water. Water is pumped from Lackamas Creek, 500 meters (1,640 feet), to Bonneville. Water is pumped to Camp Killpack from a well that is approximately 200 meters (656 feet) north of Camp Killpack. For further information, refer to Table J-13, Pipelines. HELICOPTER LANDING ZONES: There are two helicopter landing zones on Camp Bonneville. One landing zone is just south of the Bonneville cantonment area. The other landing zone is the landing strip that is used for both helicopters and fixed wing aircraft. Details are given in Table J-14, Helicopter Landing Zones. Railroads and Drop Zones are not given because these LOC items do not exist on the reservation.

TABLE J-10, ROADS

MAP NUMBER	GRID COORDINATES FROM TO	LENGTH OF ROAD	MILITARY LOAD CLASSIFICATION	ROUTE TYPE	SURFACE CONSTRUCTION MATERIAL	SURFACE WIDTH/ CONDITION	SHOULDERS CONSTRUCTION MATERIAL	SHOULDERS WIDTH/ CONDITION
1	441591–462603	2.54 km (1.58 mi)	No Data	All-weather	Asphalt	5.2 m (17 ft)/ No Data	No Data	No Data
2	455601–455602	.074 km (.046 mi)	No Data	Fair-weather	Dirt	6.0 m (19.6 ft)/ No Data	No Data	No Data
3	456601–456602	.074 km (.046 mi)	No Data	Fair-weather	Dirt	4.5 m (14.7 ft)/ No Data	No Data	No Data
4	457601–457602	.074 km (.046 mi)	No Data	Fair-weather	Dirt	3.0 m (10 ft)/ No Data	No Data	No Data
5	441577–449577	.805 km (.5 mi)	No Data	Fair-weather	Dirt	4.9 m (16 ft)/ No Data	No Data	No Data

ADDITIONAL INSTALLATION ROUTES (unnamed)

CATEGORY	TOTAL LENGTH (Approximate)
Improved Dirt Roads	8 km (5 mi)
Unimproved Dirt Roads	50 km (31 mi)

J. LINES OF COMMUNICATIONS (continued)

CAMP BONNEVILLE (continued)

TABLE J-11, ROAD BRIDGES

MAP NUMBER	ROUTE DESIGNATION	GRID COORDINATES	FEATURE CROSSED	MILITARY LOAD CLASSIFICATION	DIMENSIONS LENGTH	DIMENSIONS WIDTH	CLEARANCE HORIZONTAL	CLEARANCE VERTICAL	TYPE/CONSTRUCTION MATERIAL	CONDITION
1	No Data	451592	Lackamas Creek	No Data	12 m (40 ft)	4.6 m (15 ft)	3.9 m (13 ft)	Unlimited	Type: Deck/ Construction material: wood	Good
2	No Data	455597	Buck Creek	No Data	21 m (70 ft)	4.6 m (15 ft)	3.9 m (13 ft)	Unlimited	Type: Deck/ Construction material: wood	Good
3	No Data	457600	David Creek	No Data	11 m (35 ft)	3.7 m (13 ft)	3.0 m (10 ft)	Unlimited	Type: Deck/ Construction material: wood	Good

TABLE J-12, AIRFIELDS/AIRSTRIPS

MAP NUMBER; GRID COORDINATES; TYPE; AND CLASSIFICATION	ELEVATION AND STATUS	RUNWAY DESCRIPTION	TAXIWAY, PARKING APRON, AND HARDSTAND AREA DESCRIPTION	BUILDING DESCRIPTION	POL FACILITIES	NAVIGATIONAL AIDS	REMARKS
1; 443594; Airstrip; Army	Elevation: 128 m (420 ft). Status: Operational.	Runway: Dimensions: 300 m (984 ft) long; 15 m (50 ft) wide. Azimuth: 069°–249° Surface material and condition: rock surface in good condition.	None	None	None	None	Airstrip is used for both fixed wing aircraft and helicopters.

TABLE J-13, PIPELINES

MAP NUMBER	GRID COORDINATES FROM TO	STATUS	OWNERSHIP/ MAINTENANCE RESPONSIBILITY	PIPELINE CHARACTERISTICS	TANK CROSSING SITES	REMARKS
1	46156030–45656015	Operational	U.S. Government	Diameter of Pipe: 1.91 cm (0.75 in.). Total Length of Pipeline: 500 m (1640 ft). Material normally carried: water. Rated Capacity: No Data. Actual throughput: No Data.	No Data	Water pumped 500 m (1640 ft) to Bonneville from Lackamas Creek.
2	44455975–44405986	Operational	U.S. Government	Diameter of Pipe: 1.91 cm (0.75 in.). Total Length of Pipeline: 200 m (656 ft). Material normally carried: water. Rated Capacity: No Data. Actual throughput: No Data.	No Data	Water pumped from well 200 m (656 ft) north of Camp Killpack to Camp Killpack.

NOTE: Eight digit grid reference coordinates were used to increase the accuracy of some locations.

TABLE J-14, HELICOPTER LANDING ZONES

MAP NUMBER	GRID COORDINATES	DIMENSIONS LENGTH	DIMENSIONS WIDTH	AZIMUTH	ELEVATION	SURFACE DESCRIPTION	RESTRAINTS	REMARKS
1	456599	91 m (300 ft)	61 m (200 ft)	Approximately 160°–340°	Approximately 122 m (400 ft)	Grass	None	Landing zone just south of Bonneville cantonment area in open grass area.
2	443595	91 m (300 ft)	15 m (50 ft)	Approximately 069°–249°	Approximately 122 m (400 ft)	Grass	None	Helicopter landing zone is used for both fixed wing aircraft and helicopters.

YAKIMA FIRING CENTER

Lines of Communications (LOC) at Yakima Firing Center are depicted on the accompanying LOC map. Supportive information for LOC as shown on the graphic is provided in Tables J-15 through J-18 following this summary. ROADS: The existing road network is comprised of hard surface, improved dirt, and unimproved dirt roads. Together, they provide Yakima Firing Center with approximately 491 kilometers (305 miles) of roads that have been depicted on the map to represent prevailing patterns and system connections. Of the 491 kilometers (305 miles) approximately 51 kilometers (31 miles) of hard surface and improved dirt roads have been selected to be depicted in the table. The majority of roads comprising the road network at Yakima Firing Center fall into the category of unimproved dirt roads. Because of their similar characteristics, they have been treated as a group rather than individually and are not shown in the table. Refer to Table J-15, Roads, for individual road details. AIRFIELDS/AIRSTRIPS: There is one airfield, Yakima Firing Center Army Airfield, and one airstrip, Selah Airstrip, on the reservation. Refer to Table J-16, Airfields/Airstrips, for details. PIPELINES: There are 34 Federally-owned underground water pipeline segments on the reservation. Refer to Table J-17, Pipelines, for details. FORDS: Fords plotted on the map cross perennial streams. Most stream beds on the base are generally dry and can be crossed wherever the banks are not too steep. Poor fording conditions exist for brief periods following late spring and autumn cloudbursts, and after chinooks (warm winds) have rapidly melted winter snow cover. For detailed information, see Table B-11, Surface Drainage. HELICOPTER LANDING ZONES: There are six helicopter landing zones on the reservation, most of which are located adjacent to abandoned airstrips. Refer to Table J-18, Helicopter Landing Zones, for details. Data on Road Bridges, Railroads and Drop Zones are not given because these LOC items do not exist on the reservation.

TABLE J-15, ROADS

ROUTE NAME	GRID COORDINATES FROM TO	LENGTH OF ROAD	MILITARY LOAD CLASSIFICATION	ROUTE TYPE	SURFACE CONSTRUCTION MATERIALS	SURFACE WIDTH/ CONDITION	SHOULDERS CONSTRUCTION MATERIALS	SHOULDERS WIDTH/ CONDITION
Seventh Ave.	036723–939720	10.16 km (6.31 mi)	No Data	All-weather	Asphalt	9.1 m (30 ft)/Good	No Data	No Data
Cold Creek Rd.	040700–767644	33.66 km (20.91 mi)	No Data	Fair-weather	Gravel	No Data	No Data	No Data
Cold Creek Rd.	040700–033723	2.54 km (1.58 mi)	No Data	All-weather	Asphalt	No Data	No Data	No Data
Sixth Ave.	942719–945719	.39 km (.24 mi)	No Data	All-weather	Asphalt	4.9 m (16 ft)/Good	No Data	No Data
Fifth Ave.	942717–948717	.79 km (.49 mi)	No Data	All-weather	Asphalt	6.7 m (22 ft)/Good	No Data	No Data
Fourth Ave.	942715–948716	.62 km (.39 mi)	No Data	All-weather	Asphalt	4.9 m (16 ft)/Good	No Data	No Data
A St.	940717–940720	.32 km (.20 mi)	No Data	All-weather	Asphalt	7.6 m (25 ft)/Good	No Data	No Data
B St.	942716–942720	.48 km (.30 mi)	No Data	All-weather	Asphalt	6.1 m (20 ft)/Good	No Data	No Data
C St.	946714–946720	.62 km (.39 mi)	No Data	All-weather	Asphalt	6.1 m (20 ft)/Good	No Data	No Data
D St.	948715–948720	.48 km (.30 mi)	No Data	All-weather	Asphalt	6.7 m (22 ft)/Good	No Data	No Data
E St.	950718–950720	.56 km (.35 mi)	No Data	All-weather	Asphalt	7.3 m (24 ft)/Good	No Data	No Data

ADDITIONAL INSTALLATION ROUTES (unnamed)

CATEGORY	TOTAL LENGTH (Approximate)
Improved Dirt	52 Km (32 mi)
Unimproved Dirt Roads	388 Km (241 mi)

YAKIMA FIRING CENTER (continued)

TABLE J-16, AIRFIELDS/AIRSTRIPS

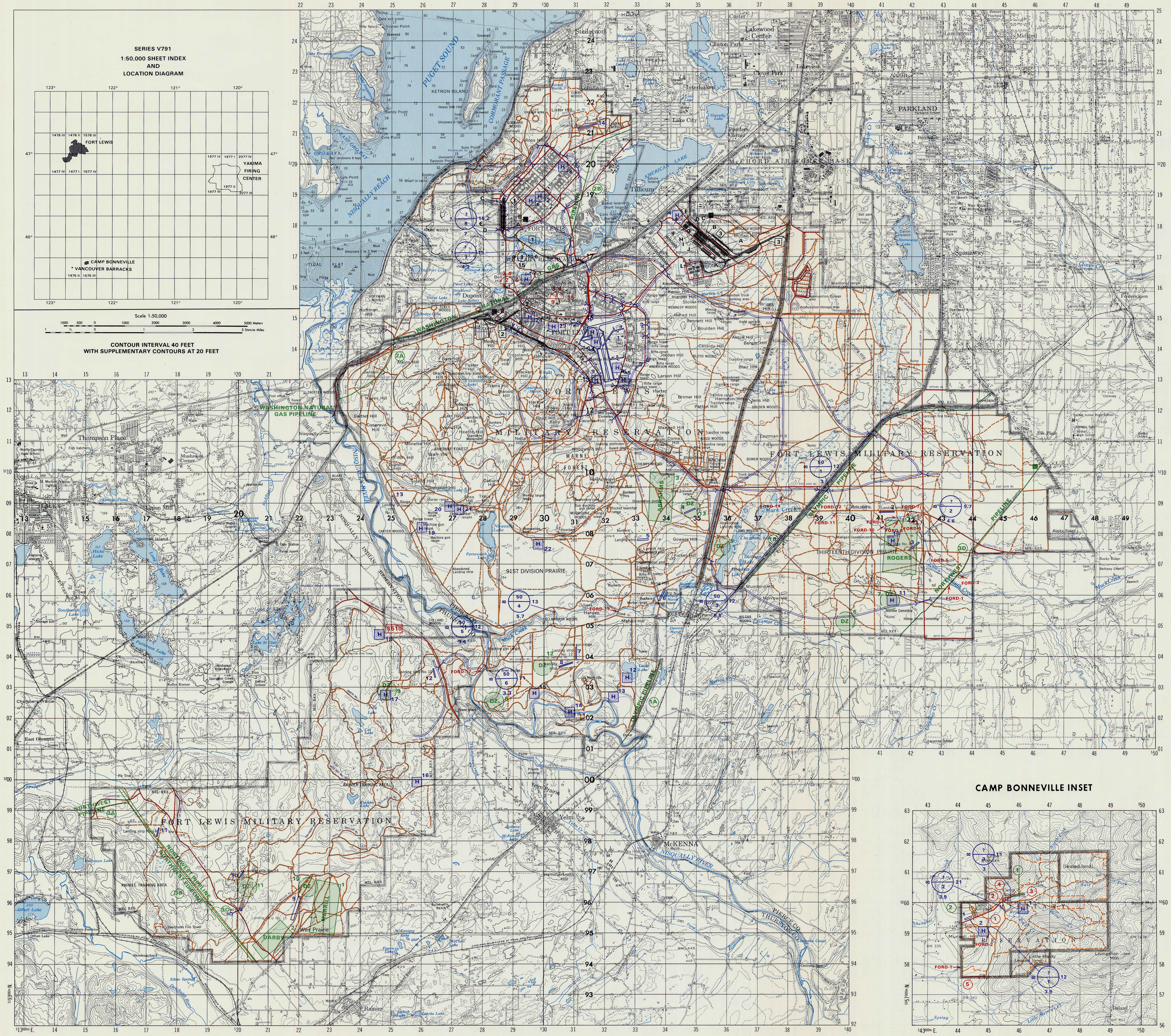
MAP NUMBER AND NAME; GRID COORDINATES; TYPE; AND CLASSIFICATION	ELEVATION AND STATUS	RUNWAY DESCRIPTION	TAXIWAY, PARKING APRON, AND HARDSTAND AREA DESCRIPTION	BUILDING DESCRIPTION	POL FACILITIES	NAVIGATIONAL AIDS	REMARKS
1. Yakima Firing Center Army Airfield; 946714; Airfield; Army	Elevation: 418 m (1370 ft). Status: Operational.	Runway: Dimensions: 610 m (2000 ft) long; 15 m (50 ft) wide. Runway has 243 m (800 ft) overruns. Azimuth: 050°-230° Surface material and condition: Asphaltic concrete in good condition.	Parking apron, and hardstand areas: Approximately 208,026 m^2 (2,239,250 ft^2). Surface material: Bituminous concrete.	None	None	Control Tower: 11 m (35 ft) high, 429 m (1405 ft) above sea level. Communications: Three frequencies: UHF 241, VHF 126.20, FM 41.50 Control has two Class A phones and a hot-line to Crash Rescue Fire Station and Ambulance Station.	For helicopter use normally. Prior permission required for multi-engine F/W aircraft. A 45-foot power pole and two Bonneville Power Administration 85-foot poles project into the glide path of the west approach and have been protected with red obstruction lighting.
2. Selah Airstrip; 043766; Airstrip; Army.	Elevation: 646 m (2120 ft). Status: Operational.	Runway: Dimensions: 1402 m (4600 ft) long; 23 m (75 ft) wide. Azimuth: 114°-294°	Taxiway: One with width of 18 m (60 ft). Surface material: Bituminous concrete. Parking Areas: Approximately 9715 m^2 (104,580 ft^2).	None	None	No Data	For both fixed wing and rotary wing aircraft.

TABLE J-17, PIPELINES

MAP NUMBER	GRID COORDINATES FROM	GRID COORDINATES TO	LENGTH OF SEGMENT	STATUS	OWNERSHIP/ MAINTENANCE RESPONSIBILITY	PIPELINE CHARACTERISTICS	TANK CROSSING SITES
1	977762	978756	0.7 km (0.4 mi)	Operational	U.S. Government	Information given below is for all 34 segments: Type: Water Construction material/Pressure capacity: Polyethylene/ 7.03 kg/cm^2 (100 psi) Diameter: 2.54 cm (1 in.) Rated capacity: 26-35 liters/min (6-8 gal/min) Depth buried: 30.5-45.7 cm (12-18 in.) Note: Transports water from springs to troughs. Trough capacity: 2202 liters (500 gal) Trough dimensions: 1.2 m × 3.7 m × 48 cm deep (4 ft × 12 ft × 19 in.) See Water Resources Map for location of water troughs.	No Data
2	973706	019725	6.5 km (4.0 mi)	Operational	U.S. Government		No Data
3	981731	985723	0.9 km (0.6 mi)	Operational	U.S. Government		No Data
4	008700	011698	0.4 km (0.2 mi)	Operational	U.S. Government		No Data
5	999766	016825	8.3 km (5.2 mi)	Operational	U.S. Government		No Data
6	011809	019812	0.9 km (0.6 mi)	Operational	U.S. Government		No Data
7	020775	024768	0.8 km (0.5 mi)	Operational	U.S. Government		No Data
8	025789	041691	11.5 km (7.1 mi)	Operational	U.S. Government		No Data
9	029697	036699	0.7 km (0.4 mi)	Operational	U.S. Government		No Data
10	038695	059692	2.9 km (1.8 mi)	Operational	U.S. Government		No Data
11	029898	144890	12.7 km (7.9 mi)	Operational	U.S. Government		No Data
12	148927	137890	4.0 km (2.5 mi)	Operational	U.S. Government		No Data
13	120889	124877	1.8 km (1.1 mi)	Operational	U.S. Government		No Data
14	099889	089878	2.3 km (1.4 mi)	Operational	U.S. Government		No Data
15	070896	067883	1.3 km (0.8 mi)	Operational	U.S. Government		No Data
16	229740	290748	7.4 km (4.6 mi)	Operational	U.S. Government		No Data
17	270736	289729	2.3 km (1.4 mi)	Operational	U.S. Government		No Data
18	263735	259726	1.1 km (0.7 mi)	Operational	U.S. Government		No Data
19	714627	732621	4.5 km (2.8 mi)	Operational	U.S. Government		No Data
20	728610	740598	2.1 km (1.3 mi)	Operational	U.S. Government		No Data
21	738604	744607	0.7 km (0.4 mi)	Operational	U.S. Government		No Data
22	712618	717619	0.4 km (0.2 mi)	Operational	U.S. Government		No Data
23	298619	720600	4.7 km (2.9 mi)	Operational	U.S. Government		No Data
24	274636	281601	4.0 km (2.5 mi)	Operational	U.S. Government		No Data
25	271636	232617	6.1 km (3.8 mi)	Operational	U.S. Government		No Data
26	227683	230689	0.7 km (0.4 mi)	Operational	U.S. Government		No Data
27	229658	235647	1.7 km (1.1 mi)	Operational	U.S. Government		No Data
28	220656	220659	0.4 km (0.2 mi)	Operational	U.S. Government		No Data
29	204638	187627	2.3 km (1.4 mi)	Operational	U.S. Government		No Data
30	174666	195656	3.6 km (2.2 mi)	Operational	U.S. Government		No Data
31	182657	186654	0.5 km (0.3 mi)	Operational	U.S. Government		No Data
32	155683	160681	0.5 km (0.3 mi)	Operational	U.S. Government		No Data
33	140674	172650	4.7 km (2.9 mi)	Operational	U.S. Government		No Data
34	130637	158646	3.0 km (1.9 mi)	Operational	U.S. Government		No Data

TABLE J-18, HELICOPTER LANDING ZONES

MAP NUMBER AND NAME	GRID COORDINATES	DIMENSIONS	AZIMUTH	ELEVATION	SURFACE DESCRIPTION	RESTRAINTS	REMARKS
1. Poverty Flats	997758	Dimensions: 676 m (2220 ft) long. 41 m (135 ft) wide.	No Data	616 m (2020 ft)	Dirt	None	Adjacent to abandoned airstrip.
2. Selah Airstrip	044763	Cannot be determined.	No Data	640 m (2100 ft)	Dirt	None	Helipad at same location as airstrip.
3. Paradise Valley	075744	Cannot be determined.	No Data	640 m (2100 ft)	Dirt	None	Adjacent to abandoned airstrip.
4. Cold Creek	079700	Cannot be determined.	No Data	689 m (2260 ft)	Dirt	None	Adjacent to abandoned airstrip.
5. Washout Gulch	056627	Cannot be determined.	No Data	518 m (1700 ft)	Dirt	None	Adjacent to abandoned airstrip.
6. Coffin Ranch	254672	Cannot be determined.	No Data	899 m (2950 ft)	Dirt	None	Adjacent to abandoned airstrip.



FORT LEWIS, WASHINGTON

(Including Camp Bonneville, Vancouver Barracks and Yakima Firing Center)

TERRAIN ANALYSIS

LINES OF COMMUNICATION

FORT LEWIS-CAMP BONNEVILLE

ROADS

- Hard surface, 4 lane
- Hard surface, 2 lane
- Improved dirt road
- Unimproved dirt road
- Tank trail
- Tank crossing
- S510 State route number
- 5 Camp Bonneville road identification number

BRIDGE DATA
(Measurements in Meters)

A. Military load classification[1]
B. Bridge number
C. Vertical clearance
D. Horizontal clearance
E. Length
∞ Unlimited vertical clearance
? Data not available

[1] Washington state highway load classification, not converted to military load classification

FORDS

FORD-16 Fords shown on the LOC map are limited to commonly used sites that serve as connecting links in the road network. The complete fording system is shown on the surface drainage map.

TUNNELS
(Measurements in Meters)

A. Number
B. Length
C. Overall width
D. Overhead clearance

RAILROADS

- 1 Railroad with identification number
- 1 Team yard
- A Segment of team yard
- Engine house

RAILROAD BRIDGES
(Measurements in Meters)

A. Bridge number
B. Vertical clearance
C. Horizontal clearance
D. Length
∞ Unlimited vertical clearance

AIRFIELD/AIRSTRIPS

- 1 Airfield
- 2 Airstrip

PIPELINES

- 1A Pipeline with identification number
- Pumping station

HELICOPTER LANDING ZONES

- H 25 Landing zone

DROP ZONES

- ABRAHMS 1 Drop zone
- DZ 1 Drop zone (inactive)

Number refers to entry in table.

Prepared by the Terrain Analysis Center, U. S. Army Engineer Topographic Laboratories, Fort Belvoir, Virginia, March 1977. Cartographic and Reproduction Support by the Defense Mapping Agency Hydrographic/Topographic Center, Washington, D. C. December 1978.

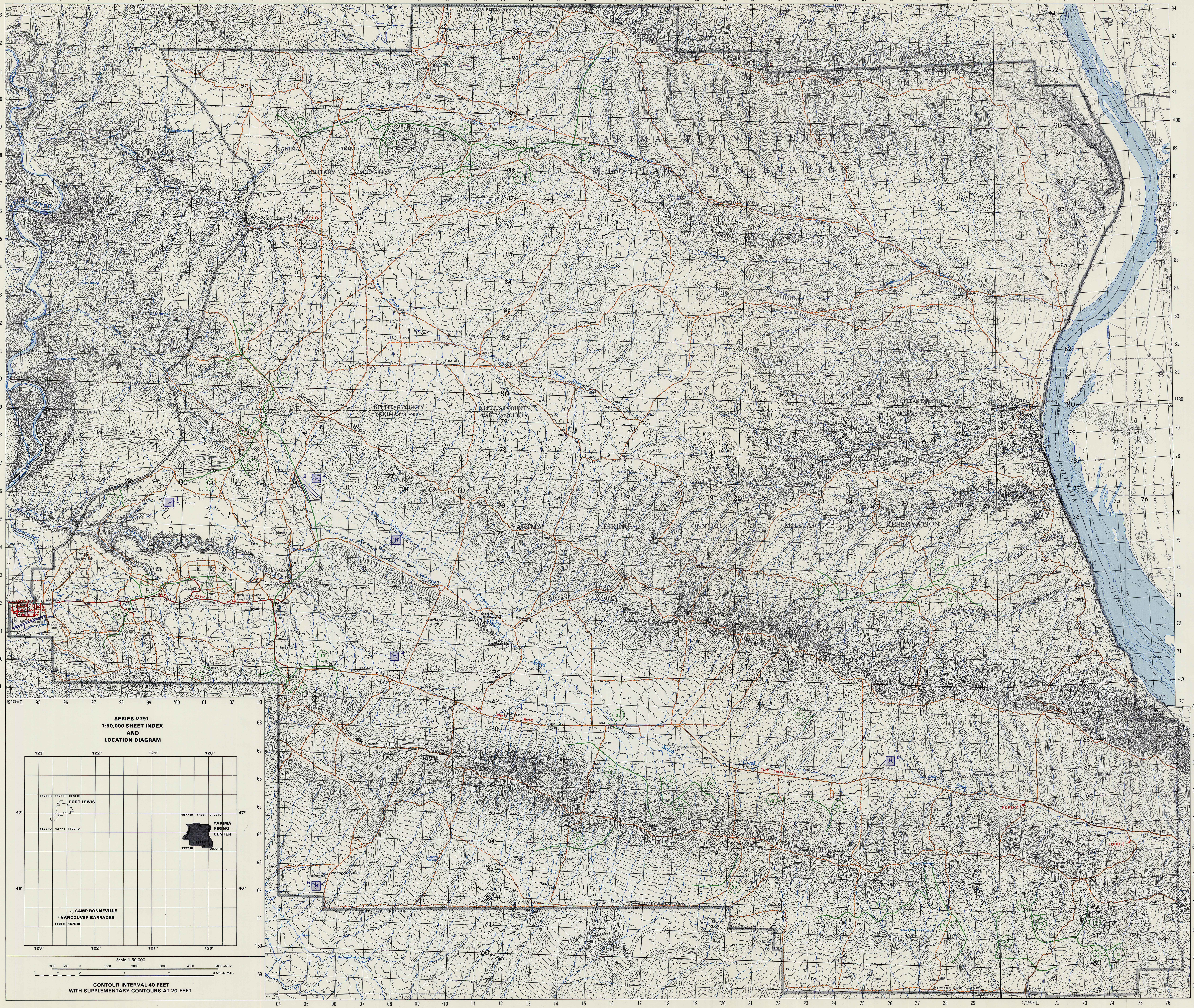
FORT LEWIS, WASHINGTON

(Including Camp Bonneville, Vancouver Barracks and Yakima Firing Center)

TERRAIN ANALYSIS

LINES OF COMMUNICATION

YAKIMA FIRING CENTER



ROADS

Hard surface, 2 lane

Improved dirt road

Unimproved dirt road

FORDS

FORD-3 Fords shown on the LOC are limited to commonly used sites that serve as connecting links in the road network. See Table B-11, Fords in Surface Drainage.

AIRFIELD/AIRSTRIPS

1 Airfield

2 Airstrip

PIPELINES

34 Pipeline

HELICOPTER LANDING ZONES

H 6 Landing zone

Number refers to entry in table

Prepared by the Terrain Analysis Center, U. S. Army Engineer Topographic Laboratories, Fort Belvoir, Virginia, March 1977. Cartographic and Reproduction Support by the Defense Mapping Agency Hydrographic/Topographic Center, Washington, D. C. December 1978.

K. URBAN AREAS (CANTONMENT AREAS)

FORT LEWIS

The cantonment lies in the northernmost central area of the Fort Lewis Military Reservation and is cut through by Interstate Highway 5. It partly surrounds American Lake, which provides boating and beach recreation areas for the post. The highway and lake, in addition to other natural and artificial terrain features divide this cantonment into five major sections: Main Fort Lewis, North Fort Lewis, Fort Lewis Logistics Center, Northeast Fort Lewis, and Madigan Army Medical Center. The acreage of the areas described totals approximately 6,416 acres, or roughly 7 percent of the total reservation. Selected area and point features within the cantonment area are located and identified on the map. Additional selected data are provided in the text and tables that follow.

TROOP BILLETS AND QUARTERS

TROOP BILLETS AND QUARTERS: Temporary troop billets are located on North and Northeast Post and permanent billets are east and southwest of Gray AAF. Modernization of permanent billets is underway. When this is accomplished, intended capacity will be reduced to 8,955. A new EM barracks complex is scheduled for completion by September 1978. It is being built just west of Gray AAF between 17th and 20th Streets and Railroad and Stryker Avenues. When completed, intended capacity will be 1,485 EM spaces.

All housing on post is of permanent construction. Presently, a modernization program is underway, but capacity in 1980 is expected to be the same.

TABLE K-1, TROOP BILLETS

TYPE	TOTAL NUMBER	TOTAL CAPACITY	CONDITION	REMARKS
Permanent	68 buildings	11,134 EM	Good	
Temporary	494 structures	15,157 spaces (approx)	Fair to poor	

TABLE K-2, QUARTERS

TYPE	TOTAL NUMBER	TOTAL CAPACITY	CONDITION	REMARKS
Bachelor	4 permanent	81	Good	
Officers	3 semi-permanent	70		
Quarters	66 temporary	1,157	Fair	
TOTAL	73 buildings	1,308 officers		
Bachelor Enlisted Quarters	7 temporary	129	Fair	108 spaces are double room size. 21 spaces are single room size.
Officers	239 single	239	Good	
Family	144 duplex	288	Good	
Quarters	21 four-family	84	Good	
	6 five-family	30	Good	
	40 six-family	240	Good	
TOTAL	450 buildings	881 families		
Enlisted	82 single	82	Good	
Family	717 duplex	1,434	Good	
Quarters	12 five-family	60	Good	
	39 six-family	234	Good	
	98 eight-family	784	Good	
TOTAL	948 buildings	2,594 families		

TABLE K-3, ELECTRIC POWER

ELECTRIC: Electric power is furnished by the city of Tacoma and also supplied by the Puget Sound Power and Light Company. Energy is delivered from the city's Cowlitz Substation to the Army Central Substation (UTM Grid 334168) and from the city's Cushman Substation to the South Fort Substation (UTM Grid 297142).

The condition of Army Central and South Fort Substations is poor. At Army Central, there is insufficient interrupting capacity, and the relays and oil circuit breakers are in a deteriorated condition. At South Fort, the metal clad switchgear needs upgrading. In over 45 years of existence, Army Central has operated without any major repairs being done on it. South Fort is less than 20 years old.

Capacity for both substations is expected to be the same in 1980; however, the base is shifting from fossil fuel heating to electric heating. In order to meet the attendant increase in demand for electric supply and to distribute the power supply load more evenly, first plans for the future are to increase the capacity of South Fort to 40,000 KVA. The eventual goal for both substations is 112,000 KVA (to supply a completely electrified post).

SUBSTATION	CAPACITY	LOAD	REMARKS
Army Central	40,000 KVA	Peak: 19,000 KVA Average: 12,350 KVA	It has never been necessary to operate the substations at greater than 60% of capacity.
South Fort	20,000 KVA	Peak: 9,000 KVA Average: 5,850 KVA	
Army Central and South Fort	Maximum power deliverable in any one month is 25,000,000 KWH.	Peak power consumption in winter is 13,800,000–14,000,000 KWH, and is as low as 10,000,000 KWH in the summer. Average monthly consumption for 1976 is 12,000,000 KWH.	

TABLE K-4, HEATING

HEATING: The Washington Natural Gas Company has extended distribution lines to residential heating units, the Guest House, the new Pacific National Bank of Washington, Officers Open Mess, the NCO Open Mess and the Post Laundry. All supply and distribution pipelines, meters and regulators are the property of the Washington Natural Gas Company. Presently, no major problems exist and there are no plans for expansion. Capacity in 1980 is expected to be the same. However, the Gas Company has cut through and put in an 8-inch line and a 6-inch line from the DuPont interchange to the northeast corner of Fort Lewis and onward to McChord AFB in anticipation of any possible need for expansion.

CAPACITY	LOAD
840,000 CF/hr (6,299,440 therms/mo)	Average yearly consumption: 115,000 therms/mo Peak: 170,000 therms/mo (Jan and Feb 76) Minimum: 60,000 therms/mo (8 Jul to 8 Aug 75)

TABLE K-5, WATER

WATER: Water supply is obtained from springs at Lake Sequalitchew and wells on post. Three pipeline branches (two 12-inch and one 8-inch) from the springs at Lake Sequalitchew bring in part of Fort Lewis' water and thr rest of the post's needs are met by the wells. North post relies almost entirely on piped water from the lake (wells on north post have sanded out). Potentially this poses a problem, for if one 12-inch line goes out of service the remaining 12-inch and 8-inch lines do not have enough capacity to fully supply north Fort Lewis.

The electrically powered pumping capacity from the springs is 11,000 GPM. There are two standby diesel pumps with a total capacity of 3,000 GPM (1,500 GPM each).

The status and/or capacity of wells on post is as follows:

Well numbers 1, 2, 3, and 5 are sanded out and not considered as sources any longer. Numbers 4 and 7 are filled in and no longer usable.

Number 6 = 1,400 GPM (equipped with a standby diesel pump.)
Number 8 = 800 GPM (equipped with a standby diesel pump.)
Number 9 = 135 GPM (for golf course area; feeds clubhouse, etc.)
Number 10 = 55 GPM (there are two pumps on this well; one with 25 GPM capacity and a booster with 30 GPM capacity.)
Number 12a = 2,000 GPM
Number 12b = 1,300 GPM (is a gallery.)
Number 13 = 900GPM (equipped with a standby diesel pump.)
Number 14 = 1,000 GPM
Number 16 = 1,200 GPM
Number 17 = 500 GPM

TABLE K-5, WATER (continued)

CAPACITY	LOAD
20,300 GPM (29,232,000 GPD–24 hour period.)	Average: winter— 5,000,000 GPD summer—10,000,000 GPD Peak: winter—no peaks summer—21,000,000 GPD

TABLE K-6, SEWERAGE

SEWERAGE: The sanitary sewerage system consists of two main trunk sewers converging at the sewage treatment plant at Solo Point Bluff in the northern part of the reservation on Puget Sound. Presently, the system is experiencing problems with leaking lines and a coverage system evaluation is being planned. There are no plans for expansion at this time and capacity in 1980 is expected to be the same.

CAPACITY	LOAD
Operating capacity of 7,000,000 GPD Peak hydraulic capacity of 15,000,000 GPD	Average: summer—2,500,000–3,000,000 GPD winter—7,000,000 GPD Peak: 7,500,000–8,000,000 GPD

COMMUNICATIONS

COMMUNICATIONS: The Signal Communication facilities at Fort Lewis consist of the Telecommunication Center, Telephone Plant and Post Radio System.

The inside telephone plant consists of the following installations:

One 3,000-line attended exchange with 8 operator positions, 2 information positions, and one chief operator position.

One 3,200-line, unattended exchange.

One 800-line, unattended exchange (Fort Lewis Logistics Center).

These exchanges are connected to city of Tacoma exchanges by means of 177 city trunks.

Outside Telephone Plant-cables fan out to 1,225 cable terminals, and there are 1,568,160 feet of buried and aerial cable.

The Telecommunications Center also has a high speed data facility (DCT 9000) providing secure teletype, data card and magnetic tape input/output for all military users in the Fort Lewis area, including service to Navy and Marine units in Tacoma. Additionally, it performs alternate route functions for McChord Air Base when required.

Post Radio System-The MARS Facility located at North Fort Lewis is primarily a receiving station; however, communications are maintained with MARS nets and overseas stations.

TABLE K-7, SCHOOLS

SCHOOLS: For dependents of military families living off post, adequate elementary school facilities are available in the neighboring communities of Tillicum, Lakewood, Steilacoom, Lacey, Olympia, Yelm, Roy, Parkland, Spanaway, Puyallup and the major city of Tacoma. Tillicum Elementary School is considered an on-post facility for the assignment of students.

Woodbrook Junior High School, Clover Park High and Lakes High School, although technically off post, are considered as on-post facilities for the assignment of students.

Schools in the vicinity include the University of Washington, a state institution located in Seattle, 50 miles to the north; Seattle University, a denominational school also located in Seattle; University of Puget Sound, a denominational school in Tacoma, 17 miles to the north; Pacific Lutheran University at Parkland, 13 miles to the northeast; Evergreen College in Olympia; and, St. Martin's College at Lacey, 12 miles to the southwest. The above are all fully accredited institutions of higher learning.

There are, in addition, community colleges offering two years of advanced courses within the 50-mile radius from Fort Lewis.

SCHOOL NUMBER AND NAME	CAPACITY*	CURRENT ENROLLMENT	PROJECTED ENROLLMENT 1980
1 Greenwood	376	389	512
2 Clarkmoor	295	387	541
3 Parkway	385	474	626
4 Hillside	386	481	671
5 Beachwood	280	429	518

*Difference between capacity and enrollment is due to portable classrooms.

HOSPITALS

HOSPITALS: Currently, Madigan General Hospital houses a capacity of 1,448 beds. The original Madigan General Hospital structure was constructed during WW II (1943–44) and has reached such a state of obsolescence that feasibility studies have been conducted to determine the practicality of updating the existing facility or replacing it with a new structure. The Master Plan includes a new multi-story structure (500 beds, 800,000 square feet), to be located near Filmore Avenue and Fifth Street, in northeast Fort Lewis. Construction is scheduled to begin in approximately 1983.

The original 138-bed Post Hospital, Building 4290, constructed in 1929 is now utilized as the Main Post Dispensary.

Helipad located in field adjacent to Building 9993.

The Dental Clinic (Building 3204) with a 26 chair capacity was constructed in 1957 near the center of the divisional troop areas.

The combined dispensary and 6-chair dental clinic is sited in Area 9, southwest of Gray Field. Also a large dental clinic (28 chairs and 15,215 square feet) is scheduled for completion by September 1978 in Area 9. Central Troop Medical Clinic (53,500 square feet) to be built in Area 4.

TABLE K-8, RECREATION FACILITIES

FACILITY	TOTAL NUMBER	FACILITY HOUSING: PERMANENT OR TEMPORARY	REMARKS
Theaters	5	4 Permanent, 1 Temporary	
Music and Theatre (live)	1	Temporary	
Bowling Centers	2	Both Permanent	One 24-lane and one 12-lane. Planned changes include closing the 12-lane facility and adding 16 lanes at the 24-lane facility before the end of 1978.
Skill Development Center	1	Temporary	Offers a variety of crafts and hobbies.
Auto Repair Shop	1	Permanent	
Boat Repair Shop	1	Semi-permanent	
Gymnasiums	4	2 Permanent, 2 Temporary	A new Physical Fitness Center (field house) of 64,000 square feet is planned for construction in the FY 1980 program.
Swimming Pool	1		
Libraries	3	2 Permanent, 1 Temporary	Plans to expand the main library by about 15,000 square feet are being considered.
EM Service Clubs	4	1 Permanent, 3 Temporary	
Youth Center	10		
Football Stadium	1		Unlighted.
Baseball Stadium	1		Lighted.
Softball Fields	12		One quadruple set of fields on north post is unlighted. Another quadruple set at the airfield is lighted. A third quadruple set of unlighted fields is located just south of the EM barracks complex on the southwest end of the Gray AAF runway.
Golf Course	2		There is a 9-hole golf course adjacent to and east of the present 18-hole course.

There is a Rod and Gun Club on post, however, this is a private association.
In addition, there are beach areas, picnic areas, and boating facilities along American Lake.

CAMP BONNEVILLE

The Camp Bonneville Military Reservation lies about 13 miles east of Vancouver, Washington and about 7 miles north of Camas, Washington. Two small cantonments are located in the northwest quadrant of the 3,840-acre reservation; Camp Bonneville and Camp Killpack. Each cantonment covers about 10 and 11 acres respectively for a total of 21 acres or about 0.5 percent of the total reservation. This post is utilized by reservists and National Guardsmen for periodic training.

TABLE K-9, TROOP BILLETS

TYPE	TOTAL NUMBER	CAPACITY	CONDITION	REMARKS
Temporary	22	333		

TABLE K-10, QUARTERS

TYPE	TOTAL NUMBER	CAPACITY	CONDITION	REMARKS
Enlisted (NCO) Family Housing	1	1 family		This one unit at Camp Bonneville provides quarters for the Range NCO.

TABLE K-11, ELECTRIC POWER

ELECTRIC: The post receives its power supply from Clark County Public Utilities District No. 1. It is estimated that by November 1978 there will be a greater demand for power due to the completion of a new sewerage system on post. At least two, and possibly three, more transformers (capacity and size yet unknown) will be installed to meet this new demand. Otherwise, demand for power on post varies greatly between troop training periods, but power supply has always been more than adequate to meet the load.

SUBSTATION	SUPPLY CAPACITY	LOAD	REMARKS
	10 transformers supplying 91.5 KVA	Peak power consumption for one month period of 17 Feb 74 to 17 Mar 74; 57 KWH. Consumption throughout 1975 was fairly constant at 45 KWH per month.	

HEATING

HEATING: The heating of buildings is provided by space heaters, either coal or fuel oil fired, with the exceptions of the pump house and the fire station which are heated by thermostatically controlled electric heaters. There are no planned changes being considered.

WATER

WATER: Water for Camp Killpack is produced from a 193-foot deep well equipped with a Fairbanks Morse Turbine Pump containing eighteen 10-foot sections, 4 inches in diameter, and a 5-foot lift stage. The water from this well is pumped into the 10,000 gallon reservoir. This pump, with automatic controls, and reservoir provide the water for domestic and fire protection use in the Killpack area. Water is distributed from this reservoir in a 4-inch main.

Water for Camp Bonneville is produced from an automatically controlled 250 gallon per minute pump that lifts water from the stream at Camp Bonneville and pumps into a 4-inch cast iron main which is connected to an 80,000 gallon storage reservoir located on a hill north of the main camp. Water service to Buildings T-1833, T-1834, T-1848, T-1837, T-1940 and T-1934 is provided through a 1 1/2-inch service line. Water sevice to Buildings T-1980, T-1971 and to the recreational area is through a 1-inch service line. Only Buildings T-4155, T-4398, T-4397, T-4389, T-4378, T-4368, T-4337 and T-4364 are provided with water service connections at Camp Killpack.

All water used at Camp Bonneville (Killpack included) is produced from these two sources and is chlorinated at the pumping stations.

SEWERAGE

SEWERAGE: Sewage disposal for the Camp Bonneville area is divided into two distinct sections:

a. Sewage for Camp Killpack drains by gravity flow into cesspools and/or septic tanks. These tanks are located in the vicinity of Buildings T-4165, T-4398 and T-4368. Overflow from these tanks drains through porous pipe 1,400 feet to an outlet in the stream that runs through the installation.

b. Sewage for main camp drains by gravity flow into a septic tank (Structure T-1982) located in the vicinity of Building T-1980. Overflow from this septic tank is drained through 6-inch OD steel pipe for 850 feet through the stream that runs through the installation. This outlet is located approximately 300 feet downstream from the pond area.

Expanded and improved treatment with primary and secondary treatment facilities are under construction and due for completion about October 1978.Capacity will be upgraded considerably.

COMMUNICATIONS

COMMUNICATIONS: Interior telephone service is provided by the use of installed field wire and organic telepones of using units. There is one communication telephone located in the camp area headquarters office, Building T-1971, which is the property of the Pacific Telephone Company and is used for communications to Vancouver Barracks and the local community.

SCHOOLS

SCHOOLS: There are no schools on the post.

HOSPITALS

HOSPITALS:There is no hospital on post.

RECREATION FACILITIES

RECREATION FACILITIES: A small recreation area of approximately 15 acres exists along the Lackamas Creek adjacent and south of the Camp Bonneville cantonment area. This area is suitable for picnic-type activities.

Hunting and fishing within this small reservation have been limited to active and retired military personnel, reservists, and the local civilian population when available and not in conflict with scheduled training activities.

YAKIMA FIRING CENTER

This cantonment lies next to the extreme western boundary of Yakima Firing Center Military Reservation and just east of Interstate Highway 82. Total acreage of the cantonment is about 123 acres, roughly .04 percent of the total reservation.

TROOP BILLETS AND QUARTERS

TROOP BILLETS AND QUARTERS: Buildings in the cantonment area consist of temporary, frame-type structures which are old and in poor condition.

TABLE K-12, TROOP BILLETS

TYPE	TOTAL NUMBER	CAPACITY	CONDITION	REMARKS
Temporary	27 1/2	1,870	Poor	Some buildings have been modified to accommodate the increasing number of enlisted women. There are long-range plans for MCA/MCAR construction of an EM barracks complex.

TABLE K-13, QUARTERS

TYPE	TOTAL NUMBER	CAPACITY	CONDITION	REMARKS
Bachelor Officers Quarters	3	201		On-post housing is not available for married personnel.
Bachelor Enlisted Quarters	1	20		

TABLE K-14, ELECTRIC POWER

ELECTRIC: Power is supplied by the Pacific Power and Light Company by one 12.74/7.2 KV overhead feeder circuit from the city of Yakima, Washington to The Firing Center. The present condition of facilities is fair and there are no plans for expansion at this time. Capacity in 1980 is expected to remain the same.

SUBSTATION	CAPACITY	LOAD	REMARKS
	4,837 KVA	Average: 1,100 KVA Peak power consumption is 750,000 KWH; minimum consumption is 400,000 KWH. Average monthly consumption for 1976 was 500,000 KWH.	The peak load has always been less than 60 percent of capacity.

HEATING

HEATING: The distribution systems are designed to provide adequate heat for all existing and proposed buildings from one central heating plant in each block. Steam supply mains range from 2 inches to 6 inches in size and are carried on overhead supports (none underground). Return lines range from 1 1/2 inches to 3 inches in size and are carried overhead on the same supports as the mains.

Fuel oil facilities for heating purposes consist of four 12,000-gallon oil tanks at each central heating plant in the barracks area. Two 12,000-gallon tanks are provided at the warehouse heating plant. Three shops each have a 6,000-gallon oil storage tank, and one shop has a 12,000-gallon oil storage tank.

The boilers are installed in permanent buildings.

Other buildings not included in the central heat distribution system have oil-fired space heaters, except 3 shop buildings which have oil-fired low pressure steam, and one shop building which has an oil-fired high pressure steam plant.

All existing steam distribution systems were constructed in 1951 and are considered adequate.

No modifications are required except as are necessary for new additions incurred by expansion of the built-up areas.

TABLE K-15, WATER

WATER: Potable water is pumped from three wells. A 600,000-gallon steel storage reservoir provides a fire fighting potential as well as a limited reserve supply in case of a temporary power outage. Main lines are in good condition but lateral lines are in need of replacement or repair. This supply system is adequate for the needs of the station.

WELL	CAPACITY GPM
Pomona	650
Marie's	210
Southeast	65
Total	925

TABLE K-16, SEWERAGE

SEWERAGE: The plant is a permanent construction and affords primary and secondary treatment of sewage; digestion and air drying sludge beds. The liquid effluent is chlorinated and discharged into the Yakima River. There are no plans for expansion presently; however, a chlorine contact and mixing chamber has been added to upgrade the system to comply with EPA standards. Facilities are all in fair to good condition. The only modification anticipated will be addition of new lines necessitated by possible expansion of building areas.

CAPACITY	LOAD
The sewerage treatment plant has an operating capacity of 720,000 gallons discharge per day, and serves a maximum population of about 5,000–7,200.	The load fluctuates with the troop strength on post. Average load: winter (about 1,000 people)-100,000 GPD Average load: summer (approximately 17,000 persons)-225,000 GPD Peak load: summer 1976 550 to 600,000 GPD

YAKIMA FIRING CENTER (continued)

COMMUNICATIONS

COMMUNICATIONS: The communications system on post is owned by Pacific Northwest Bell and leased to the Army. Located in Building 140 (also the Post Headquarters Building), it includes 7 circuits to Fort Lewis, 2 autovon trunks, 5 trunks to the city of Yakima, and 10 tie-trunks between the Army-owned and Pacific Northwest Bell Telephone system. There exists a range communications system consisting of over 75 miles of open wire. Emergency field phones are available in some of the field training areas. The system currently has a capacity of 200 numbers or subscribers.

Two cable projects are slated for the future: first, a 6-pair around the impact area; and second, a 12-pair from BM 2010 to BM 2088 proceeding down Hansen Creek Road to the Columbia River during FY 1979.

SCHOOLS

SCHOOLS: There are no schools on the post.

HOSPITALS

HOSPITALS: There are no hospital facilities, as such, on the post. Building T-159 serves as a dispensary and infirmary for the Post. There are six concrete tent slabs which provide the facilities for a 50-bed tent hospital during maneuvers and summer camps, manned by a Field Hospital Unit detailed from Fort Lewis for the purpose. During other periods, hospital facilities in the city of Yakima are utilized for emergency cases with the US Government paying the hospital claims. Helicopters land on a large open grassy field across from (south of) Building T-157. There is a MAST helicopter arrangement to airlift emergency cases to one of two nearby Yakima hospitals. A dispensary and dental clinic are possible additions in the future, but still beyond the present 5-year plan.

TABLE K-17, RECREATION FACILITIES

RECREATION FACILITIES: There has been an increased effort to upgrade and build recreation facilities and programs. New soccer fields, softball fields and picnic areas (with tables, horseshoe pits, and barbecue pits) have been added. The craft shop is equipped for a wide variety of trades and an array of recreation equipment is available for check-out. In addition, assigned personnel are allowed membership privileges at the new multimillion dollar YMCA facility in Yakima, under an agreement with the U.S. Government.

All the buildings housing the various recreation facilities on post, however, are temporary and in poor condition.

Two areas on the reservation are open for public fishing. Kiddies Pond is available for use by children under 12 years of age and Taylor Pond may be used by anyone. The ponds are stocked with rainbow trout in cooperation with Washington State Department of Game. Hunting is also open to the public.

FACILITY	TOTAL NUMBER	FACILITY HOUSING: PERMANENT OR TEMPORARY	REMARKS
Multi-purpose Recreation Court Areas	3		
Softball Fields	3		
Craft Shop	1	Temporary	
Library	1	Temporary	
Service Club	1	Temporary	
Theater	1	Temporary	
Boxing Ring	1		Outdoors between barracks areas. Centered on a line between recreation court facility number 249 and boiler plant building 248.

VANCOUVER BARRACKS

This cantonment lies within the city of Vancouver just east of Interstate Highway 5. Measuring 62 acres, it is the smallest of the Fort Lewis sub-installations.

TROOP BILLETS AND QUARTERS

TROOP BILLETS AND QUARTERS: There are no troop billets at Vancouver Barracks.

TABLE K-18, QUARTERS

TYPE	TOTAL NUMBER	CAPACITY	CONDITION	REMARKS
Officers Family Housing	2	2 families	Good	
Enlisted (NCO) Family Housing	7	14 families	Good	

TABLE K-19, ELECTRIC POWER

ELECTRIC: The post receives its power supply from one 2.4 KV 3-wire 3 phase feeder from the Public Utility District Number 1 of Clark County. The district's Bridge Substation, from which power to the post is furnished, is located approximately one-half mile distant. This station is rated 3000 KVA 11/2.4 KV.

SUBSTATION	SUPPLY CAPACITY	LOAD	REMARKS
Bridge	23 transformers supplying 291 KVA.	Peak power consumption: 235 KWH for period 12 Oct to 8 Nov 76. Low power consumption: 157 KWH for period 12 Jun to 11 Jul 75.	Load will expand by at least 10% by 1980.

TABLE K-20, HEATING

HEATING: The Northwest Natural Gas Company delivers natural gas to Vancouver Barracks through a 4-inch main. There are 55 metered services installed on the post and supplied through lines owned and maintained by the gas company. There are 49 metered services for U.S. Army garrison activities, one service to the Veterans Administration laundry, and the remainder to Washington Army National Guard units. Supply is more than adequate and there are no plans for change.

SUPPLY CAPACITY	LOAD	REMARKS
No Data	Peak: 55,299.2 therms for month of Feb 74. Low: 1705.1 therms for month of Aug 76.	Demand may decrease in the coming years.

WATER

WATER: Vancouver Barracks purchases its water from the city of Vancouver. The water supply comes from two sources; spring and deep wells. This water is pumped into two roofed-over reservoirs; one of one million gallon capacity and the other of four million gallon capacity. Reservoirs are adjacent to one another and cross-connected.

Vancouver Barracks is served from the city's 18-inch cast iron water main with one 8-inch cast iron connection at the western boundary of the post and East Fourth Street. An 8-inch steel line connects the 18-inch city main on Fort Vancouver Way, north of the post, with the post distribution system in McClelland Road, east of the McLoughlin intersection.

SEWERAGE

SEWERAGE: Vancouver Barracks sanitary sewers north of Fifth Street, and from Building 408 and 410 south of Fifth Street, drain by gravity flow into the city of Vancouver interceptor sewer system located in southeast Fifth Street, which in turn flows to and through the city's sewage treatment plant. Sewage generated south of Fifth Street, except as noted above, flows directly into the Columbia River.

The existing system on the upper or North Post (above Fifth Street) is adequate for current and future requirements. Future development would require the installation of additional service on the lower or south portion of the installation only.

COMMUNICATIONS

COMMUNICATIONS: The telephone cable on post is owned by the U.S. Government with the exception of minor adaptions made by the Pacific Telephone and Telegraph Company. The cables are leased to Pacific Northwest Bell Telephone Company. The telephone company provides individual phone service to the station from their switchboards located in Vancouver, Washington, and Portland, Oregon. There are no switchboard facilities within the installation.

SCHOOLS

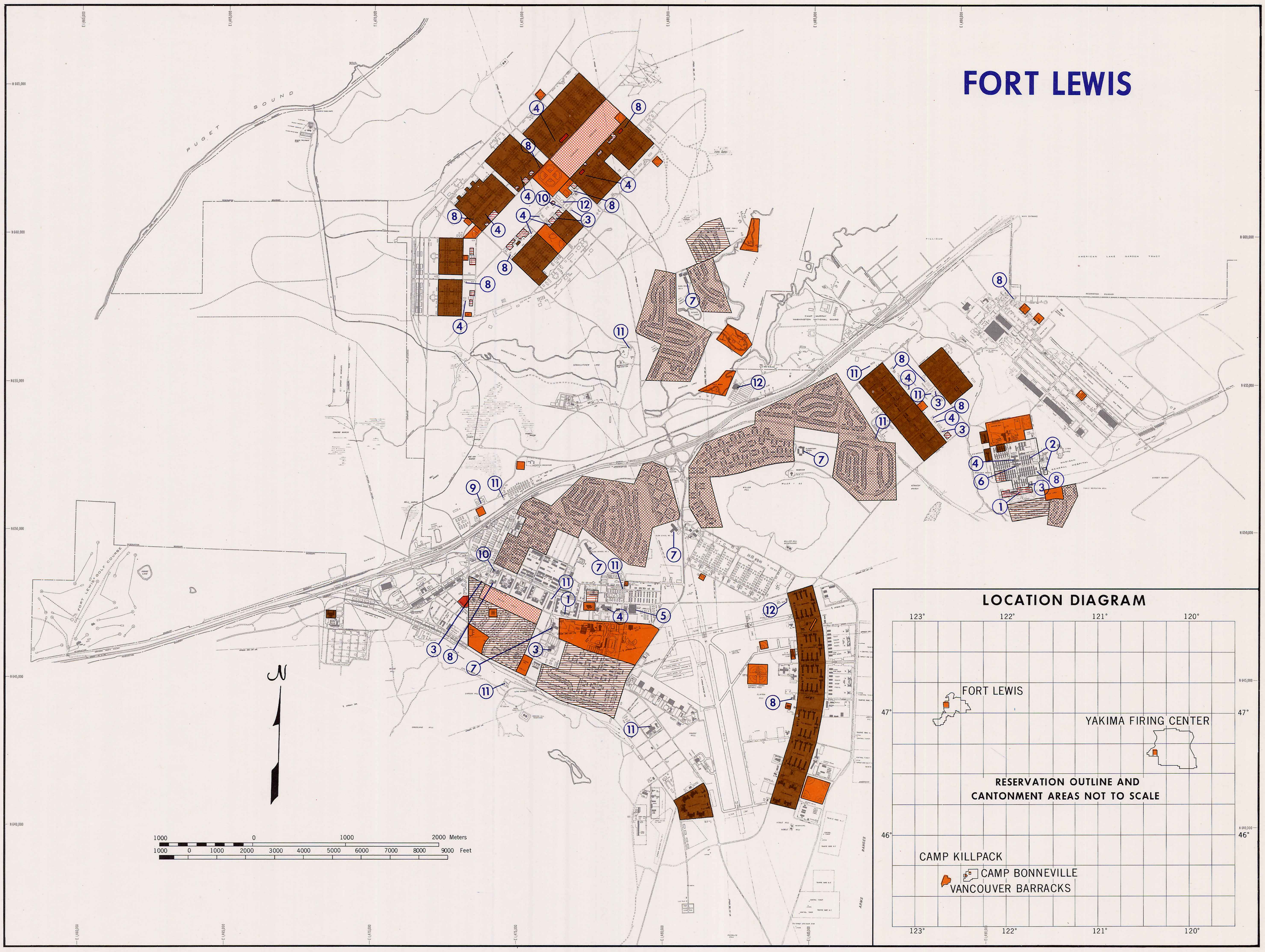
SCHOOLS: There are no schools on post.

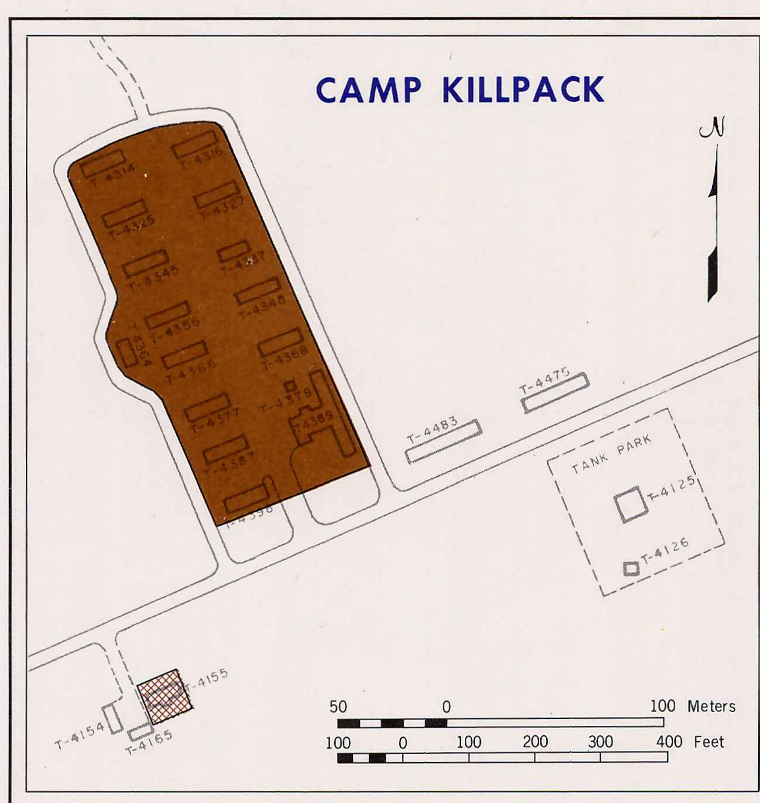
HOSPITALS

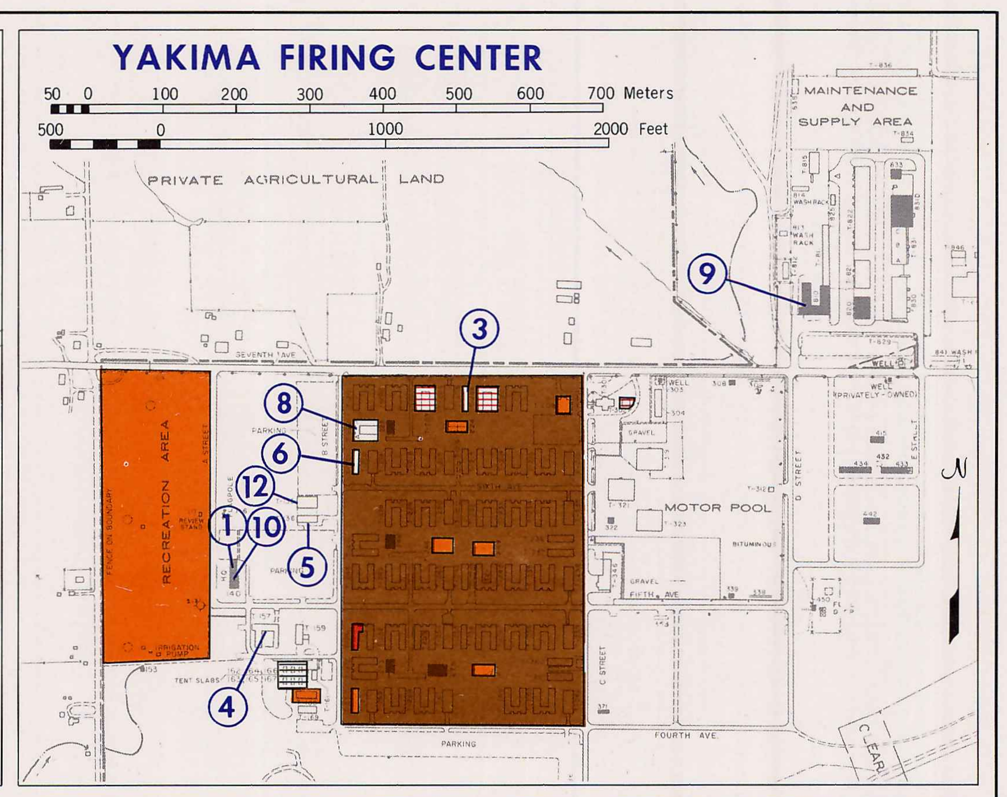
HOSPITALS: There are no hospitals on post.

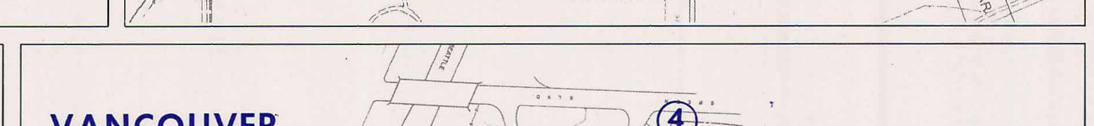
RECREATION FACILITIES

RECREATION FACILITIES: The only facilities on post are one volleyball court and one general purpose playground.









AREA FEATURES

- Family Housing, Officers
- Family Housing, NCO
- Barracks, Enlisted Quarters
- Bachelor Officer Quarters
- Bachelor Enlisted Quarters
- Guest House, Temporary Quarters
- Parade Grounds
- Recreation Facilities
- Tent Area

SITE FEATURES

1. Post Headquarters
2. Post Hospital
3. Officers Open Mess
4. Post Exchange
5. Commissary
6. Post Office
7. Elementary School
8. Chapel
9. Directorate of Facilities Engineering
10. Telephone Exchange
11. Electric Power Substation
12. NCO Open Mess

Prepared by the Terrain Analysis Center, U. S. Army Engineer Topographic Laboratories, Fort Belvoir, Virginia, March 1977. Cartographic and Reproduction Support by the Defense Mapping Agency Hydrographic/Topographic Center, Washington, D. C. December 1978.

L. NON-URBAN CULTURE FEATURES

FORT LEWIS

Non-Urban Culture Features are defined as all man-made features existing on a reservation outside of the defined cantonment area(s) that could have an effect, either positively or negatively, on military training and operations. Two hundred and eighty-four (284) non-urban culture features located outside the cantonment area but within reservation boundaries are listed and described in Table L-1, below. Feature locations are plotted on the accompanying map and are keyed to the information provided in the table by map number. Most of the non-urban culture features at Fort Lewis are associated with reservation firing ranges.

TABLE L-1, NON-URBAN CULTURE FEATURES[1]

MAP NUMBER	GRID REFERENCE[2]	DESCRIPTION				
1	30052175	VHF Omni Directional Range Beacon; fenced				
2	31302155	4 Buildings:				
		Use	No. Stories	Meters^2	(Feet^2)	Materials (Foundation, walls, roof)
		2 Range Houses	1	44.6	(480)	concrete, steel, steel
		Mess Shelter				concrete, wood, steel
		Bleacher Cover				concrete, wood, aluminum
3	31302155	Observation Tower; wood foundation, wood structure, paper roof, height 6.4 m (21 ft)				
4	27902035	Building; Latrine				
5	28002050	Boat Launching Ramp; concrete				
6	29602050	2 Water Storage Tanks; fenced, covered, concrete, 750,000 gal. capacity, 30.5 m (100 ft) diameter				
7	29761390	Beacon; metal, height 38.1 m (125 ft)				
8	31002045	Antenna Field; 1-metal tower, height 18.3 m (60 ft), 1-metal tower, height 19.8 m (65 ft), one 2 wood pole antenna and one 2 metal pole antenna, heights 15.2 m (50 ft)				
9	31002045	3 Buildings:				
		Use	No. Stories	Meters^2	(Feet^2)	Materials (Foundation, walls, roof)
		Radio Receiver	1	316.6	(3,408)	concrete, wood frame, composition
		Administration	1	149.8	(1,612)	concrete, wood frame, composition
		Power Unit Shelter	1	6.5	(70)	concrete, wood frame, composition
10	31102020	Electric Substation; fenced				
11	27451980	Sewage Treatment Facility; operating capacity of 7,000,000 gpd, peak hydraulic capacity of 14,000,000 gpd,includes manually cleaned grit chambers with 2 barminutors and Parshall flumes,four 7.3m × 33.5m (24 ft × 110 ft) rectangular primary clarifiers (approximately 200,000 gal. capacity each), with sludge pit, skimming trough and sludge collectors, two 6.1 m (20 ft) high × 18.3 m (60 ft) diameter concrete digester tanks (one with a fixed concrete dome, the other with a floating steel dome), an operations house with an automatic chlorinator, a control house with sludge heating equipment, a sludge grinding building and air-drying sludge beds				
		Use	No. Stories	Meters^2	(Feet^2)	Materials (Foundation, walls, roof)
		Operations House		104.3	(1,123)	concrete, concrete, aluminum
		Control House		42	(452)	concrete, concrete, aluminum
		Sludge Grinding Building		111.5	(1,200)	concrete, concrete, aluminum
12	27201937	4 Buildings: CBR Proficiency Range No. 2				
		Use	No. Stories	Meters^2	(Feet^2)	Materials (Foundation, walls, roof)
		Gas Chamber	1	111.5	(1,200)	concrete, wood, composition
		2 Range Houses	1	44.6	(480)	concrete, steel, steel
		Bleacher Cover				wood, wood, aluminum
13	27701905	Observation Tower; 1 story, wood foundation, wood structure, roll paper roof, height 6.4 m (21 ft)				
14	27701905	2 Buildings; 1 Range House, 1 story, 44.6 m^2 (480 ft^2), concrete foundation, steel walls, steel roof, and 1 Latrine				
15	28021905	Observation Tower; concrete foundation, wood structure, aluminum roof, height 6.4 m (21 ft)				
16	28051905	5 Buildings: Trainfire Range No. 102				
		Use	No. Stories	Meters^2	(Feet^2)	Materials (Foundation, walls, roof)
		Range House	1	44.6	(480)	concrete, steel, steel
		Range House	1	49	(528)	concrete, wood, wood
		Mess Shelter				concrete, composition
		Bleacher Cover				concrete, wood, aluminum
		Latrine				
17	28301902	Observation Tower; wood foundation, wood structure, roll paper roof, height 6.4 m (21 ft)				
18	28351900	5 Buildings: Quick Kill Range No. 103				
		Use	No. Stories	Meters^2	(Feet^2)	Materials (Foundation, walls, roof)
		2 Range Houses	1	44.6	(480)	concrete, steel, steel
		1 Range House	1	26.8	(288)	wood, wood, wood
		2 Latrines				
19	28451890	Building; Latrine				
20	28721930	3 Buildings:				
		Use	No. Stories	Meters^2	(Feet^2)	Materials (Foundation, walls, roof)
		Firing Line Shed				wood, wood frame, metal
		Range House	1	74.3	(800)	concrete, wood, composition
		Target Storage	1	148.6	(1,600)	concrete, woodpost, composition
21	28851945	2 Buildings:				
		Use	No. Stories	Meters^2	(Feet^2)	Materials (Foundation, walls, roof)
		Firing Line Shed				wood, wood frame, metal
		General Storehouse	1	92.9	(1,000)	concrete, wood, composition
22	28981954	4 Buildings:				
		Use	No. Stories	Meters^2	(Feet^2)	Materials (Foundation, walls, roof)
		Firing Line Shed				wood, wood frame, metal
		General Storehouse	1	929	(10,000)	concrete, wood, felt & wood
		Target Storage	1	12.8	(138)	concrete, wood, composition
		Administration	1	92.9	(1,000)	concrete, wood, felt & wood
23	29051960	5 Buildings:				
		Use	No. Stories	Meters^2	(Feet^2)	Materials (Foundation, walls, roof)
		General Storehouse	1	929	(10,000)	concrete, wood, paper
		2 Target Storage	1	148.6	(1,600)	concrete, woodpost, composition
		Latrine				
		Shelter				
24	29151970	4 Buildings:				
		Use	No. Stories	Meters^2	(Feet^2)	Materials (Foundation, walls, roof)
		Target Storage	1	148.6	(1,600)	concrete, woodpost, composition
		General Storehouse	1	74.3	(800)	concrete, wood, felt & wood
		2 Latrines				
25	29141975	Moving Target Track; with protective revetment, length 61 m (200 ft), (location and alignment approximate)				
26	35751032	Revetment; length 548.6 m (1,800 ft). Average height of all revetments 6.1 m (20 ft).				
27	35601063	Revetment; length 362 m (1,187 ft)				
28	28721926	Observation Tower; wood foundation, wood structure, metal roof, height 6.4 m (21 ft)				
29	29141969	Observation Tower; 1 story, wood foundation, wood structure, metal roof, height 6.4 m (21 ft)				
30	35440969	Revetment; length 186.7 m (613 ft).				
31	35481020	Revetment; length 548.6 m (1,800 ft)				
32	29901731	Building; Latrine				
33	30201710	Building; Solvent Refined Coal Pilot Plant, experimental station for removing extraneous materials from coal and turning it into usable pellets. Covers 11.8 hectares (29.13 acres), government owned, privately operated				
34	30301720	Building; Laundry, 1 story, 5,155.9 m^2 (55,499 ft^2), concrete foundation, concrete walls, metal with built-up roofing				
35	30541714	Building; Administration, 1 story, 325.3 m^2 (3,502 ft^2), concrete foundation, woodframe walls, composition roof				
36	30721752	2 Buildings: NCO Family Housing Duplex				
		Use	No. Stories	Meters^2	(Feet^2)	Materials (Foundation, walls, roof)
		Duplex	2	478.3	(5,149)	concrete, concrete masonry units, composition
		Detached Garage	1	57.6	(620)	concrete, wood frame, composition
37	30711763	Water Treatment Facility: Sequallitchew Springs, yield 6,480,000 gpd, fenced				
		Use	No. Stories	Meters^2	(Feet^2)	Materials (Foundation, walls, roof)
		Pump House	1	57.2	(616)	concrete, wood frame, composition
		Chemical Feed Facility	1	68.8	(741)	concrete, wood with clay tile or brick, built-up roofing
		Water Treatment Plant	1	168	(1,808)	concrete, concrete masonry units, composition
38	30841770	Building; General Storehouse, 37.2 m^2 (400 ft^2), concrete foundation, wood walls, metal roof				
39	30801766	Electric Substation; 750 KVA, 1 story, concrete slab				
40	34101081	Revetment; length 102.9 m (338 ft)				
41	30701712	Water Well with Pumping Station; 1 story, 30.9 m^2 (333 ft^2), concrete foundation, metal walls, built-up roofing				
42	30521706	Building; Motor Repair Shop, 1 story, 288.7 m^2 (3,108 ft^2), concrete foundation, wood frame walls, composition roof and wash platform, concrete slab, 148.6 m^2 (1,600 ft^2)				
43	31091699	Building; Open Cabana, 1 story, 31.2 m^2 (336 ft^2), concrete foundation, wood walls, wood roof				
44	31701725	6 Buildings:				
		Use	No. Stories	Meters^2	(Feet^2)	Materials (Foundation, walls, roof)
		BBQ Shelter	1	87.1	(938)	concrete, wood frame, composition
		Latrine	1	18.6	(200)	concrete, wood frame, composition
		Recreation Building	1	98.1	(1,056)	concrete, wood frame, wood
		Club House	1	332.8	(3,582)	concrete, wood frame, wood
		Snack Bar	1	23.8	(256)	concrete, wood frame, composition
		Trailer Maintenance Shop	1	111.5	(1,200)	concrete, metal, metal
45	31951730	Building; NCO Open Mess, 2 story, 3,517.2 m^2 (37,860 ft^2), concrete foundation, concrete walls, built-up roofing				
46	32531743	9 Buildings: Rod and Gun Club				
		Use	No. Stories	Meters^2	(Feet^2)	Materials (Foundation, walls, roof)
		Clubhouse	1	161.3	(1,736)	concrete, stone, composition
		General Storehouse	1	92.2	(992)	concrete, wood frame, composition
		Recreation Building	1	111.5	(1,200)	post, wood frame, metal
		6 Dog Shelters	1	46.8	(504)	wood, wood, wood
47	35331040	Revetment; length 415.3 m (1,363 ft)				
48	33921822	Water Well with Pumping Station; fenced, 1 story, 35.7 m^2 (384 ft^2), concrete foundation, concrete masonry unit walls, built-up roofing				

L. NON-URBAN CULTURE FEATURES (continued)

FORT LEWIS (continued)

TABLE L-1, NON-URBAN CULTURE FEATURES[1]

MAP NUMBER	GRID REFERENCE[2]	DESCRIPTION / Use	No. Stories	Meters²	(Feet²)	Materials (Foundation, walls, roof)
49	34301865	Monument; 13.1 m² (141 ft²), concrete foundation, stone walls, metal roof				
50	25201442	9 Buildings: Fort Lewis Golf Course				
		Clubhouse	1	622.1	(6,696)	concrete, wood frame, composition
		Pro Shop	1	324	(3,488)	concrete, wood frame, composition
		3 Maintenance	1	42.2	(454)	concrete, wood frame, metal
		Maintenance	1	159.8	(1,720)	concrete, wood frame, composition
		Maintenance	1	277	(2,982)	concrete, wood frame, composition
		Maintenance	1	63.5	(683)	concrete, wood frame, metal
		Vehicle Storage	1	232.3	(2,500)	concrete, wood frame, composition
51	25151470	Building; Golf Shelter, 1 story, 223 m² (2,400 ft²), concrete foundation, wood frame walls, composition roof				
52	25361510	Building; Latrine, 1 story, 7.4 m² (80 ft²), concrete foundation, concrete masonry unit walls, built-up roofing				
53	25321464	2 Water Wells with Pumping Station; 1 story, 12.3 m² (132 ft²), concrete foundation, wood and metal walls, composition roof				
54	25741530	Water Well with Pumping Station; 1 story, 26 m² (280 ft²), concrete foundation, concrete walls, concrete masonry unit roof				
55	25721475	Building; Latrine, 1 story, 7.4 m² (80 ft²), concrete foundation, concrete masonry unit walls, built-up roofing				
56	29051450	5 Buildings: Trainfire Range				
		Target Storage	1	89.2	(960)	concrete, wood, composition
		Target Storage	1	398.5	(4,290)	concrete, masonry units, wood, composition
		General Storehouse	1	89.2	(960)	concrete, wood frame, composition
		General Storehouse	1	74.3	(800)	concrete, wood frame, composition
		Latrine	1	13.4	(144)	concrete, wood frame, composition
57	29541426	7 Buildings: Trainfire Range				
		Range House	1	44.6	(480)	concrete, steel, steel
		2 Latrines	1	13.4	(144)	concrete, wood frame, composition
		General Storehouse	1	74.3	(800)	concrete, wood frame, composition
		General Storehouse	1	713.5	(7,680)	concrete, wood, composition
		2 Shelters				
58	29401435	Observation Tower; height 6.4 m (21 ft)				
59	29641408	Electric Substation; 10,000 KVA, concrete slab, metal rack				
60	29651394	Pet Cemetery				
61	29761390	2 Buildings: Radio Facility				
		Generator Building	1	13.4	(144)	concrete, concrete masonry units, built-up roofing
		VFW Building	1	23.8	256)	concrete, concrete masonry units, built-up roofing
62	29761390	Antenna Tower; wood support, height 21.3 m (70 ft): 3 single pole antennas; height 21.3 m (70 ft), 24.4 m (80 ft), and 27.4 m (90 ft)				
63	29891384	2 Water Storage Tanks; covered, reinforced concrete, 500,000 gal. capacity, 20.7 m (68 ft) diameter, height 9.1 m (30 ft), fenced				
64	30471372	4 Buildings; Target Detection Range, 2 Latrines, Shelter, Bleachers				
65	34001071	Revetment; length 201.9 m (663 ft)				
66	32541645	Water Storage Tank; with Valve House, 1 story, covered, steel, 500,000 gal. capacity, 19.5 m (64 ft) diameter				
67	32551570	2 Water Storage Tanks; covered, reinforced concrete, 500,000 gal. capacity, 19.8 m (65 ft) diameter				
68	32301413	Building; Radio Receiver, fenced, 1 story, 17.1 m² (184 ft²), concrete foundation, concrete masonry unit walls, built-up roofing				
69	32291432	Quadruple Lighted Softball Field; fenced, includes Special Services Office, 1 story, 99.6 m² (1,027 ft²), concrete foundation, concrete masonry unit walls, built-up roofing				
70	32291496	3 Buildings; 2 Latrines and a Review Stand, 526.7 m² (5,670 ft²), concrete foundation, wood walls, metal roof				
71	32311464	Softball Field				
72	32501445	Helicopter Mock-up; wood foundation				
73	33331373	2 Buildings; Trainfire Range No. 3, includes a Latrine and a Range House, 1 story, 44.6 m² (480 ft²), concrete foundation, steel walls, steel roof				
74	33331378	Observation Tower; Trainfire Range No. 3, concrete foundation, wood structure, aluminum roof, height 6.4 m (21 ft)				
75	33351415	7 Buildings: Trainfire Range No. 2				
		2 Mess Shelters				wood, wood, wood
		2 Range Houses	1	44.6	(480)	concrete, steel, steel
		Equipment Storage	1	44.6	(480)	concrete, wood, wood
		2 Latrines				
76	33351420	Observation Tower; Trainfire Range No. 2, concrete foundation, wood structure, aluminum roof, height 6.4 m (21 ft)				
77	33351460	3 Buildings: Trainfire Range No. 1				
		Target Storage	1	89.2	(960)	concrete, aluminum, aluminum
		Mess Shelter				wood, wood, wood
		Latrine				
78	33351464	Observation Tower; Trainfire Range No. 1, concrete foundation, wood structure, aluminum roof, height 6.4 m (21 ft)				
79	33321514	Building; Latrine				
80	33321572	Observation Tower; Infiltration Range No. 49, wood foundation, wood structure, roll paper roofing, height 6.4 m (21 ft)				
81	34411598	Observation Tower; Pistol Range No. 45, wood foundation, metal structure, metal roof, height 6.4 m (21 ft)				
82	34451598	3 Buildings: Pistol Ranges No. 43, 44, 45				
		2 Range Houses	1	12.3	(132)	concrete, wood, wood
		Range House	1	12.3	(132)	wood, wood, wood
83	34491598	Observtion Tower; Pistol Range No. 44, wood foundation, metal structure, metal roof, height 6.4 m (21 ft)				
84	34511595	Observation Tower; Pistol Range No. 43, wood foundation, metal structure, metal roof, height 6.4 m (21 ft)				
85	35601665	2 Buildings				
		Administration	1	58.2	(627)	wood, wood frame, composition and metal
		Shear Repair Shed	1	59.9	(645)	wood, wood frame, composition
86	35371560	Observation Tower; Close Combat Range No. 40, concrete foundation, wood frame structure, metal roof, height 6.4 m (21 ft)				
87	35401574	Building; Latrine				
88	35401559	5 Buildings: Close Combat Range No. 40				
		Range House	1	44.6	(480)	concrete, steel, steel
		Range House	1	74.3	(800)	wood, wood, wood
		2 Shelters				
		Latrine				
89	36461670	2 Buildings; Disposal Yard, fenced, includes a Sentry building and a latrine				
90	36271520	Observation Tower; Combat Fire Range No. 39, wood foundation, wood structure, wood roof, height 6.4 m (21 ft)				
91	36301525	2 Buildings; Combat Fire Range No. 39, 2 Range Houses, 1 story, 44.6 m² (480 ft²), concrete foundation, steel walls, steel roof				
92	37131470	Ruins; old concrete foundation				
93	37201465	4 Buildings: Hand Grenade Range No. 34				
		Shelter				wood, wood, wood
		Storage	1	22.5	(242)	concrete, wood, wood
		2 Latrines				
94	37211466	Observation Tower; Hand Grenade Range No. 34, wood foundation, wood structure, roll paper roofing, height 6.4 m (21 ft)				
95	38001505	2 Buildings; U.S.A.T.C. Bivouac Area No. 7, a Latrine and a Mess Hall, 1 story, 89.2 m² (960 ft²), concrete foundation, wood walls, composition roof				
96	38171535	6 Chemical Storage Igloos; fenced, 3-1 story, 149.4m² (1,608 ft²), concrete foundation, concrete walls, concrete/built-up roofing, 3-1 story, 99.3 m² (1,069 ft²), concrete foundation, concrete walls, concrete/built-up roofing				
97	38021645	2 Buildings: Acid Storage Facility, fenced				
		Acid Storage	1	111.5	(1,200)	concrete, metal, metal
		Alcohol Storage	1	37.2	(400)	concrete, metal, metal
98	38451610	Ordnance Storage Area: fenced				
		Administration	1	110.2	(1,186)	concrete, concrete masonry units, composition
		Administration	1	58	(624)	concrete masonry units, wood frame, composition
		Administration	1	111.5	(1,200)	concrete, metal, metal
		Loading Dock	1	177.3	(1,908)	concrete, concrete, composition
		Fixed Ammo Magazine	1	1,151	(12,400)	concrete, concrete masonry units, composition
		Fixed Ammo Magazine	1	166.3	(1,790)	concrete, concrete, concrete
		Sentry Station	1	3.3	(36)	concrete masonry units, wood frame, built-up
		9 Fixed Ammo Igloos	1	180.3	(1,941)	concrete, concrete, concrete
		6 Fixed Ammo Igloos	1	149.4	(1,608)	concrete, concrete, concrete
		17 Fixed Ammo Igloos	1	149.4	(1,608)	concrete, concrete, concrete/built-up
99	26851311	Building; Sentry Station, 1 story, 37.2 m² (400 ft²), wood foundation, wood walls, wood roof				
100	26891310	Goodman Lookout Tower No. 72, height 33.5 m (110 ft)				
101	27301315	Building; E.O.D. Disposal Site No. 68, Range House, 1 story, 38.4 m² (413 ft²), concrete foundation, wood walls, metal roof				
102	32701281	2 Water Storage Tanks; fenced, 1-covered, reinforced concrete, 500,000 gal. capacity, 18.3 m (60 ft) diameter, 1-covered steel, 800,000 gal. capacity, 19.8 m (65 ft) diameter, with valve chamber 22.5 m² (242 ft²), reinforced concrete				
103	33061308	3 Buildings: Trainfire Range No. 5				
		Range House	1	12.8	(138)	concrete piers, wood, wood

L. NON-URBAN CULTURE FEATURES (continued)

FORT LEWIS (continued)

TABLE L-1, NON-URBAN CULTURE FEATURES[1]

MAP NUMBER	GRID REFERENCE[2]	DESCRIPTION / Use	No. Stories	Meters²	(Feet²)	Materials (Foundation, walls, roof)
		Range House	1	44.6	(480)	concrete, steel, steel
		Latrine				
104	33061309	Observation Tower; Trainfire Range No. 5, concrete foundation, wood structure, aluminum roof, height 6.4 m (21 ft)				
105	33331353	Observation Tower; Trainfire Range No. 4, concrete foundation, wood structure, aluminum roof, height 6.4 m (21 ft)				
106	33311345	5 buildings: Trainfire Range No. 4				
		Range House	1	44.6	(480)	concrete, steel, steel
		Target Storage	1	89.2	(960)	concrete, aluminum, aluminum
		Mess Shelter	1	92.9	(1,000)	wood, wood, wood
		Shelter				
		Latrine				
107	28101105	Crankhite Monument				
108	29801075	Building; Toxic Gas Storage Shed, 9.8 m² (105 ft²), concrete foundation, wood walls, composition roof				
109	30441090	Building; Gas Chamber, 1 story, 111.5 m² (1,200 ft²), concrete foundation, wood walls, asphalt roof				
110	30501100	Building; Latrine				
111	31211174	10 Buildings:				
		Recreation Building	1	200.7	(2,160)	concrete, wood, composition
		Snack Bar	1	7.9	(85)	wood, wood, wood
		4 Skeet Houses	2	11.9	(128)	concrete, concrete and wood, composition
		Skeet House	1	5.9	(64)	concrete, concrete, composition
		2 Trap Houses	1	9.3	(100)	concrete, concrete, concrete
		Latrine				
112	31611202	Building; General Storehouse, 1 story, 44.6 m² (480 ft²), concrete foundation, concrete masonry unit walls, built-up roofing				
113	31641198	Flag Pole; steel, height 9 m (30 ft)				
114	31851252	2 Buildings; Target Detection Range No. 1, Latrine and Shelter				
115	31651194	Post Cemetery; 1.2 hectares (3 acres)				
116	33021285	Observation Tower; Trainfire Range No. 6, concrete foundation, wood structure, aluminum roof, height 6.4 m (21 ft)				
117	33041280	5 Buildings: Trainfire Range No. 6				
		Observation Shelter				wood, wood, aluminum
		Bleacher Cover				dirt, wood, wood
		2 Range Houses	1	44.6	(480)	concrete, steel, steel
		Latrine				
118	32901240	Observation Tower; Trainfire Range No. 7, concrete foundation, wood structure, aluminum roof, height 6.4 m (21 ft)				
119	32901234	3 Buildings; Trainfire Range No. 7, includes Latrine, Shelter, and Range House, 1 story, 44.6m² (480 ft²), concrete foundation, steel walls, steel roof				
120	32751185	4 Buildings: Trainfire Range No. 9				
		Target Storage	1	89.2	(960)	concrete, aluminum, aluminum
		Range House	1	44.6	(480)	concrete, steel, steel
		Shelter				
		Latrine				
121	32771194	Observation Tower; Trainfire Range No. 9, concrete foundation, wood structure, aluminum roof, height 6.4 m (21 ft)				
122	32901219	Observation Tower; Trainfire Range No. 8, concrete foundation, wood structure, aluminum roof, height 6.4 m (21 ft)				
123	32901212	2 Buildings; Trainfire Range No. 8, Latrine and Mess Shelter, wood foundation, wood walls, wood roof				
124	32751100	C-124 Mock-up				
125	32661115	3 Buildings; 2 Latrines, 1 Shelter				
126	32801125	Building; Obstacle Course No. 1, Aluminum Bleacher Cover				
127	32881111	C-5A Mock-up				
128	32001213	Building; Latrine				
129	32921091	2 Buildings; Target Detection Range No. 7, Latrine and Shelter				
130	33251095	5 Buildings: Trainfire Range No. 12				
		Range House	1	44.6	(480)	concrete, steel, steel
		Storage	1	44.6	(480)	concrete, steel, steel
		Shelter				wood, wood, wood
		Shelter				
		Latrine				
131	33301095	Observation Tower; Trainfire Range No. 12, concrete foundation, wood structure, aluminum roof, height 6.4 m (21 ft)				
132	33631080	4 Buildings: Known Distance Range No. 13				
		Firing Line Shed				dirt, plywood, aluminum
		Range House	1	44.6	(480)	concrete, steel, steel
		Range House	1	89.2	(960)	concrete, aluminum, aluminum
		Latrine				
133	33751070	Building; Latrine				
134	33801095	Building; Storage, 1 story, 23.2 m² (250 ft²), concrete foundation, wood walls, wood roof				
135	33751070	Observation Tower; Trainfire Range No. 14, concrete foundation, wood structure, aluminum roof, height 6.4 m (21 ft)				
136	33891064	3 Buildings: Trainfire Range No. 15				
		Shelter				wood, wood, wood
		Range House	1	44.6	(480)	concrete, steel, steel
		Latrine				
137	33931064	Observation Tower; Trainfire Range No. 15, concrete foundation, wood structure, aluminum roof, height 6.4 m (21 ft)				
138	34041085	Building; Storage, 1 story, 92.2 m² (1,000 ft²), wood walls, roll paper roof				
139	34141080	Building; Storage, 1 story, 92.9 m² (1,000 ft²), wood walls, roll paper roof				
140	34031060	Building; Latrine				
141	34121060	Observation Tower; Trainfire Range No. 16, concrete foundation, wood structure, aluminum roof, height 6.4 m (21 ft)				
142	34231053	4 Buildings: Trainfire Range No. 16				
		Range House	1	55.7	(600)	concrete, wood, wood
		Range House	1	44.6	(480)	concrete, steel, steel
		Shelter				
		Latrine				
143	34561042	Observation Tower; Trainfire Range No. 18, concrete foundation, wood structure, aluminum roof, height 6.4 m (21 ft)				
144	35001075	3 Buildings; Known Distance Range No. 20, 1 Storage, 1 Latrine and 1 Range House, 1 story, 44.6 m² (480 ft²), concrete foundation, steel walls, steel roof				
145	35221065	2 Buildings; Known Distance Range No. 21, 1 Latrine and 1 Storage				
146	35391065	Building; Trainfire and Known Distance Range No. 22, Range House, 1 story, 100.3 m² (1,080 ft²), wood walls, roll paper roof				
147	35511065	2 Buildings; Known Distance Range No. 23, 1 Latrine and 1 Storage, 1 story, 100.3 m² (1,080 ft²), wood walls, roll paper roof				
148	35961064	Building; Trainfire Recordfire Range No. 26, Range House, 1 story, 55.7 m² (600 ft²), concrete foundation, wood walls, composition roof				
149	36001073	Observation Tower; Trainfire Recordfire No. 26, concrete foundation, wood structure, metal roof, height 6.4 m (21 ft)				
150	33341071	2 Buildings; Target Detection Range No. 7, 1 Shelter and 1 Range House, 1 story, 44.6 m² (480 ft²), concrete foundation, steel walls, steel roof				
151	33901045	7 Buildings:				
		Range Headquarters	1	371.6	(4,000)	concrete, wood, asphalt
		Operations		18.6	(200)	wood, roll paper
		Storage	1	23.2	(250)	concrete, wood, wood
		Storage	1	55.8	(601)	concrete, wood, wood
		Shelter				wood, wood, wood
		2 Latrines				
152	34441045	Building; Pistol Range No. 17, Range House, 1 story, 11.2 m² (121 ft²), concrete foundation, wood walls, wood roof				
153	34441045	Observation Tower; Pistol Range No. 17, Range House, wood foundation, wood structure, wood roof, height 6.4 m (21 ft)				
154	34511040	7 Buildings: Trainfire Range No. 18				
		2 Range Houses	1	92.2	(1,000)	wood, roll paper
		Range House	1	44.6	(480)	concrete, steel, steel
		Range House	1	55.7	(600)	concrete, wood, wood
		Shelter				wood, wood, wood
		Shelter				
		Latrine				
155	34571002	2 Buildings; Target Detection Range No. 9, 1 Latrine and 1 Shelter				
156	34930970	4 Buildings; 2 Storage, 1 Shelter, 1 Latrine				
157	35301004	2 Buildings; 2 Latrines				
158	35401026	Building; Trainfire Known Distance Range No. 23, Range House, 1 story, 44.6 m² (480 ft²), concrete foundation, steel walls, steel roof				
159	35661004	2 Buildings; Trainfire Known Distance Range No. 23, 2 Range Houses, 1 story, 44.6 m² (480 ft²), concrete foundation, steel walls, steel roof				
160	35420960	Building; Grenade Assault Course, Latrine				

FORT LEWIS (continued)

TABLE L-1, NON-URBAN CULTURE FEATURES[1]

MAP NUMBER	GRID REFERENCE[2]	DESCRIPTION
161	35600946	3 Buildings: Grenade Range No. 24

Use	No. Stories	Meters²	(Feet²)	Materials (Foundation, walls, roof)
2 Range Houses	1	44.6	(480)	concrete, steel, steel
Shelter				

MAP NUMBER	GRID REFERENCE	DESCRIPTION
162	35740962	Observation Tower; Grenade Range No. 24, wood foundation, wood structure, wood roof, height 6.4 m (21 ft)
163	35740962	Building; Grenade Range No. 24, Range House
164	26150955	Observation Post No. 11
165	29310955	2 Buildings: Tank Table No. 61

Use	No. Stories	Meters²	(Feet²)	Materials (Foundation, walls, roof)
Range House	1	26.8	(288)	concrete, wood, wood
Generator House	1	26.8	(288)	concrete, wood, wood

MAP NUMBER	GRID REFERENCE	DESCRIPTION
166	29681014	Building; Demolition Site No. 62, Shelter, concrete foundation, concrete walls, metal roof
167	32340969	2 Buildings: Rocket Launcher Range No. 70

Use	No. Stories	Meters²	(Feet²)	Materials (Foundation, walls, roof)
AIA Headquarters		65	(700)	concrete, wood, roll paper
General Storehouse		47.6	(512)	wood, roll paper

MAP NUMBER	GRID REFERENCE	DESCRIPTION
168	36211125	Building; Pistol Range No. 27A, Range House, 1 story, 11.8 m^2 (127 ft^2), concrete foundation, wood walls, asphalt roof
169	36211127	Observation Tower; Pistol Range No. 27A, wood foundation, wood structure, wood roof, height 6.4 m (21 ft)
170	36201120	Observation Tower; Range No. 27, concrete foundation, wood structure, metal roof, height 6.4 m (21 ft)
171	36201121	Building; Range No. 27, Range House, 1 story, 55.7 m^2 (600 ft^2), concrete foundation, wood walls, composition roof
172	36301186	Building; Trainfire Fieldfire Range No. 28, Range House, 1 story, 55.7 m^2 (600 ft^2), concrete foundation, wood walls, composition roof
173	36301190	Observation Tower; Trainfire Fieldfire Range No. 28, concrete foundation, wood structure, metal roof, height 6.4 m (21 ft)
174	36441234	Observation Tower; Trainfire Range No. 29, concrete foundation, wood structure, metal roof, height 6.4 m (21 ft)
175	36451235	Building; Trainfire Range No. 29, Range House, 1 story, 55.7 m^2 (600 ft^2), concrete foundation, wood walls, composition roof
176	36441256	Building; Trainfire Range No. 30, Range House, 1 story, 55.7 m^2 (600 ft^2), concrete foundation, wood walls, composition roof
177	36441256	Observation Tower; Trainfire Range No. 30, concrete foundation, wood structure, metal roof, height 6.4 m (21 ft)
178	36651281	Observation Tower; Trainfire Recordfire Range No. 31, concrete foundation, wood structure, metal roof, height 6.4 m (21 ft)
179	36661282	Building; Trainfire Recordfire Range No. 31, Range House, 1 story, 55.7 m^2 (600 ft^2), concrete foundation, wood walls, composition roof
180	37051364	Observation Tower; Trainfire Range No. 32, concrete foundation, wood structure, metal roof, height 6.4 m (21 ft)
181	37081358	Building; Trainfire Range No. 32, Range House, 1 story, 37.2 m^2 (400 ft^2), concrete foundation, wood walls, composition roof
182	37501352	Building; Bivouac Area No. 8, Mess Hall, 1 story, 89.2 m^2 (960 ft^2), concrete foundation, wood walls composition roof
183	37401222	Building; Bivouac Area No. 9, Mess Hall, 1 story, 89.2 m^2 (960 ft^2), concrete foundation, wood walls, composition roof
184	37401145	Building; Bivouac Area No. 10, Mess Hall, 1 story, 89.2 m^2 (960 ft^2), concrete foundation, wood walls composition roof
185	37251078	Building; Bivouac Area No. 11, Mess Hall, 1 story, 89.2 m^2 (960 ft^2), concrete foundation, wood walls, composition roof
186	37401055	Building; Bivouac Area No. 12, Mess Hall, 1 story, 89.2 m^2 (960 ft^2), concrete foundation, wood walls, composition roof
187	38701102	Building; Range House, 1 story, 44.6 m^2 (480 ft^2), concrete foundation, steel walls, steel roof
188	39751225	2 Buildings; 2 Range Houses, both are 1 story, 44.6 m^2 (480 ft^2), concrete foundation, steel walls, steel roof.
189	42261355	Building; Range House, 1 story, 44.6 m^2 (480 ft^2), concrete foundation, steel walls, steel roof
190	42471198	2 Buildings: fenced

Use	No. Stories	Meters²	(Feet²)	Materials (Foundation, walls, roof)
Sentry Station	1	44.6	(480)	concrete, wood, asphalt
General Storehouse	1	11.1	(120)	concrete, metal, metal

MAP NUMBER	GRID REFERENCE	DESCRIPTION
191	42471198	Garrison Lookout Tower No. 75; wood structure, height 33.5 m (110 ft)
192	25610800	2 Buildings: Range No. 51

Use	No. Stories	Meters²	(Feet²)	Materials (Foundation, walls, roof)
Bleacher Cover				concrete, concrete, roll paper
Range House	1	44.6	(480)	concrete, steel, steel

MAP NUMBER	GRID REFERENCE	DESCRIPTION
193	25620830	3 Buildings: Range No. 52

Use	No. Stories	Meters²	(Feet²)	Materials (Foundation, walls, roof)
Range House	1	26.8	(288)	concrete, wood, wood
Range House	1	44.6	(480)	concrete, steel, steel
Bleacher Cover				concrete, wood, metal

MAP NUMBER	GRID REFERENCE	DESCRIPTION
194	25650827	Observation Tower; Range No. 52, wood foundation, wood structure, roll paper roofing, height 6.4 m (21 ft)
195	26950885	Building; Range No. 58, Range House, 1 story, 11.2 m^2 (121 ft^2), concrete foundation, wood walls, wood roof
196	27000883	Observation Tower, Range No. 58, wood foundation, wood structure, roll paper roof, height 6.4 m (21 ft)
197	27200880	Observation Tower; Rocket Launch Range No. 59, wood foundation, wood structure, wood roof, height 6.4 m (21 ft)
198	27350898	Observation Post No. 10
199	27330886	Building; Rocket Launch Range No. 59, Range House, 1 story, 17.8 m^2 (192 ft^2), concrete foundation, wood walls, wood roof
200	28560831	Building; Mortar Range No. 66, Range House, 1 story, 44.6 m^2 (480 ft^2), concrete foundation, steel walls, steel roof
201	28560834	Observation Tower, Mortar Range No. 66, concrete foundation, wood structure, aluminum roof, height 6.4 m (21 ft)
202	29260803	Observation Post No. 9
203	30590797	Observation Post No. 8
204	30860797	Building; Range No. 68, Range House, 1 story, 44.6 m^2 (480 ft^2), concrete foundation, steel walls, steel roof
205	31800880	Observation Tower; height 6.4 m (21 ft)
206	31840901	Observation Post No. 7
207	32110899	Building; Sub-machine Gun Range No. 69, Range House, 1 story, 12.3 m^2 (132 ft^2), concrete foundation, wood walls, wood roof
208	33000735	Building; Range House, 1 story, 44.6 m^2 (480 ft^2), concrete foundation, steel walls, steel roof
209	33690748	Building; Range House, 1 story, 44.6 m^2 (480 ft^2), concrete foundation, steel walls, steel roof
210	34200750	Building; Bivouac Area No. 1, Range House, 1 story, 44.6 m^2 (480 ft^2), concrete foundation, steel walls, steel roof
211	33440666	Observation Tower; Technique of Fire Range No. 77, wood foundation, wood structure, wood with shingles roof, height 6.4 m (21 ft)
212	33450675	3 Buildings; Technique of Fire Range No. 77, 2 Shelters and a Latrine
213	33460655	Observation Tower; Defense Range No. 79, concrete foundation, wood structure, aluminum roof, height 6.4 m (21 ft)
214	33500660	5 Buildings: Defense Range No. 79

Use	No. Stories	Meters²	(Feet²)	Materials (Foundation, walls, roof)
2 Range Houses	1	44.6	(480)	concrete, steel, steel
Range House	1	12.8	(138)	concrete, wood, asphalt shingles
2 Shelters				

MAP NUMBER	GRID REFERENCE	DESCRIPTION
215	33800660	Building; Bivouac Area No. 5, Mess Hall, 1 story, 89.2 m^2 (960 ft^2), concrete foundation, wood walls, roll roofing
216	33450631	King Hill Indian Cemetery; fenced, approximately 0.4 hectares (1 acre)
217	33570620	2 Buildings: Night Assault Range No. 80

Use	No. Stories	Meters²	(Feet²)	Materials (Foundation, walls, roof)
Range House	1	44.6	(480)	concrete, steel, steel
Shelter				

MAP NUMBER	GRID REFERENCE	DESCRIPTION
218	33750597	Radio Beacon
219	34700692	Building; Bivouac Area No. 3, Range House, 1 story, 44.6 m^2 (480 ft^2), concrete foundation, steel walls, steel roof
220	35000690	Building; Bivouac Area No. 2, Range House, 1 story, 44.6 m^2 (480 ft^2), concrete foundation, steel walls, steel roof
221	35760725	Softball Field
222	35850743	3 Buildings; 2 Latrines and a Shelter
223	35760861	Abandoned Airstrip, dirt surface, approximately 609.6 m × 30.5 m (2,000 ft × 100 ft)
224	36900828	Building; Survival, Escape and Evasion Training Area, Range House, 1 story, 44.6 m^2 (480 ft^2), concrete foundation, steel walls, steel roof
225	38790790	6 Buildings
226	39900890	5 Radio Towers
227	42360780	Monument
228	42600904	4 Buildings
229	23510415	2 Buildings: fenced

Use	No. Stories	Meters²	(Feet²)	Materials (Foundation, walls, roof)
Sentry Station	1	37.2	(400)	wood, wood, wood
Compressor Shelter	1	9.3	(100)	concrete, wood & aluminum, aluminum

MAP NUMBER	GRID REFERENCE	DESCRIPTION
230	23510415	Rainier Fire Tower No. 73; concrete foundation, steel structure, height 33.5 m (110 ft)
231	29550385	2 Buildings:

Use	No. Stories	Meters²	(Feet²)	Materials (Foundation, walls, roof)
Range House	1	63.2	(680)	concrete, wood, composition
Range House	1	55.7	(600)	concrete, wood, composition

MAP NUMBER	GRID REFERENCE	DESCRIPTION
232	29590390	Observation Tower; concrete foundation, wood structure, metal roof, height 6.4 m (21 ft)
233	30250390	Observation Tower; Machine Gun Transition Range No. 91, wood foundation, wood structure, wood roof, height 6.4 m (21 ft)
234	30300390	5 Buildings: Machine Gun Transition Range No. 91

Use	No. Stories	Meters²	(Feet²)	Materials (Foundation, walls, roof)
Range House	1	44.6	(480)	concrete, steel, steel
Range House	1	12.8	(138)	concrete, wood, wood
Storage	1	74.3	(800)	concrete, wood, wood
Storage				
Latrine				

L. NON-URBAN CULTURE FEATURES (continued)

FORT LEWIS (continued)

TABLE L-1, NON-URBAN CULTURE FEATURES[1]

MAP NUMBER	GRID REFERENCE[2]	DESCRIPTION
235	31350324	Mock City
236	31900390	Building; Platoon Attack Range No. 87, Range House, 1 story, 44.6 m^2 (480 ft^2), concrete foundation, steel walls, steel roof
237	32760522	Observation Tower; Squad Attack Range No. 86, height 6.4 m (21 ft)
238	33640581	Observation Tower; Defense Range No. 81, wood foundation, wood structure, wood roof, height 6.4 m (21 ft)
239	33660591	4 Buildings: Defense Range No. 81 and Mortar Range No. 32

Use	No. Stories	Meters[2]	(Feet[2])	Materials (Foundation, walls, roof)
2 Range Houses	1	44.6	(480)	concrete, steel, steel
Bleacher Cover				concrete, wood, metal
Latrine				

MAP NUMBER	GRID REFERENCE	DESCRIPTION
240	32900340	Rappelling Tower
241	32950304	2 Buildings; Range House, 1 story, 12.8 m^2 (138 ft^2), concrete foundation, wood walls, asphalt roof, a Latrine, and training facilities to include "SLIDE FOR LIFE" and "ROPE DROP"
242	25250296	4 Buildings

Use	No. Stories	Meters[2]	(Feet[2])	Materials (Foundation, walls, roof)
2 Range Houses	1	44.6	(480)	concrete, steel, steel
2 Range Houses				

MAP NUMBER	GRID REFERENCE	DESCRIPTION
243	17659520	Building; fenced, Sentry Station, wood foundation, wood walls, wood roof
244	17659520	Deshutes Fire Tower No. 74; concrete foundation, steel structure, height 33.5 m (110 ft)
245	21009550	3 Buildings
246	41110504	Jeschke Cemetery; fenced, approximately .02 hectares (.05 acre)
247	41640520	Henry Smith Cemetery; fenced, approximately .02 hectares (.05 acre)
248	40151390	Abandoned Airstrip; grass surface, approximately 533.4 m × 45.7m (1,750 ft × 150 ft)
249		Electric Power Lines:
	From 32002093 To 32822122	110 KV-average spacing of poles, 106.7 m (350 ft)
	From 27051945 To 27501910	13.8 KV-average spacing of poles, 83.8 m (275 ft)
	From 27401930 To 27451967	13.8 KV-average spacing of poles, 83.8 m (275 ft)
	From 28741585 To 28761782	110 KV-average spacing of poles, 122 m (400 ft)
	From 30751665 To 30911790	13.8 KV-average spacing of poles, 76.2 m (250 ft)
	From 30901771 To 30051815	13.8 KV-average spacing of poles, 76.2 m (250 ft)
	From 31051735 To 32001735	13.8 KV-average spacing of poles, 68.6 m (225 ft)
	From 30651707 To 31001714	13.8 KV-average spacing of poles, 68.6 m (225 ft)
	From 33541795 To 34001770	13.8 KV-average spacing of poles, 91.4 m (300 ft)
	From 23901353 To 25651545	110 KV-average spacing of poles, 122 m (400 ft)
	From 28451475 To 29701412	110 KV-average spacing of poles, 91.4 m (300 ft)
	From 32851525 To 33411622	13.8 KV-average spacing of poles, 83.8 m (275 ft)
	From 33901645 To 38071526	13.8 KV-average spacing of poles, 122 m (400 ft)
	From 36851524 To 37171575	13.8 KV-average spacing of poles, 122 m (400 ft)
	From 32001288 To 36000960	13.8 KV-average spacing of poles, 106.7 m (350 ft)
	From 31251175 To 31521277	13.8 KV-average spacing of poles, 106.7 m (350 ft)
	From 32631145 To 33051286	13.8 KV-average spacing of poles, 106.7 m (350 ft)
	From 34281015 To 34351040	13.8 KV-average spacing of poles, 106.7 m (350 ft)
	From 34801020 To 34941060	13.8 KV-average spacing of poles, 106.7 m (350 ft)
	From 35590960 To 35601025	13.8 KV-average spacing of poles, 106.7 m (350 ft)
	From 36291131 To 37601506	13.8 KV-average spacing of poles, 122 m (400 ft)
	From 30022170 To 29852016	No Data
	From 30502029 To 31402127	No Data
	From 29650385 To 33450650	No Data
	From 26200460 To 27100260	No Data
	From 23150590 To 24700560	No Data
	From 26009815 To 26419891	No Data
	From 43751185 To 44701255	No Data
250	28101105	Crankhite Monument Cemetery
251	28600840	Ross Family Cemetery; .02 hectares (.05 acre)
252	40670810	Wren Family Cemetery; 0.4 hectares (1 acre)
253	42150590	Cemetery
254	32301413	Antenna platform; 3 poles, height 24.4 m (80 ft)
255	34441595 34491594	2 Revetments; length 61 m (200 ft) and 68.6 m (225 ft)
256	33421559	Revetment; length 102.9 m (338 ft)
257	33761465	Revetment; length 502.9 m (1,650 ft)
258	33451435	2 Revetments; length 156.2 m (513 ft) and 377.2 m (1,238 ft)
259	33441376	2 Revetments; length 213.4 m (700 ft) and 144.8 m (475 ft)
260	33691355	Revetment; length 198.1 m (650 ft)
261	33171319	Revetment; length 129.5 m (425 ft)
262	33391285	Revetment; length 400.1 m (1,313 ft)
263	33101265	3 Revetments; length 160 m (525 ft), 236.2 m (775 ft) and 201.9 m (663 ft)
264	33261237	Revetment; length 129.5 m (425 ft)
265	36311272	2 Revetments; length 232.4 m (763 ft) and 384.8 m (1,263 ft)
266	36341235	3 Revetments; length 87.6 m (288 ft), 259.1 m (850 ft) and 95.3 m (313 ft)
267	33221215	3 Revetments; length 373.4 m (1,225 ft), 243.8 m (800 ft) and 419.1 m (1,375 ft)
268	36051205	Revetment; length 240 m (788 ft)
269	33361192	Revetment; length 281.9 m (925 ft)
270	33501132	Revetment; length 586.7 m (1,925 ft)
271	33751097	Revetment; length 95.3 m (313 ft)
272	34001095 34141090	2 Revetments; length 160 m (525 ft) and 160 m (525 ft)
273	34251062	2 Revetments; length 270.5 m (888 ft) and 118.1 m (388 ft)
274	34551082 34701080	2 Revetments; length 80 m (263 ft) and 80 m (263 ft)
275	34951069 35191062	2 Revetments; length 72.4 m (238 ft) and 72.4 m (238 ft)
276	35471072 35661071	2 Revetments; length 121.9 m (400 ft) and 121.9 m (400 ft)
277	36001087	3 Revetments; length 80 m (263 ft), 403.9 m (1,325 ft) and 80 m (263 ft)
278	36131132	2 Revetments; length 87.6 m (288 ft) and 274.3 m (900 ft)
279	29200931	Revetment; length 281.9 m (925 ft)
280	32300976	Moving Target Track; with protective revetment; length 217.2 m (713 ft)
281	33651090	Revetment; length 320 m (1,050 ft)
282	33751084	Revetment; length 236.2 m (775 ft)
283	33801075	Revetment; length 205.7 m (675 ft)
284	33951090	Revetment; length 102.9 m (338 ft)

[1] Status as of November 1976.
[2] Eight digit grid reference coordinates were used to increase the accuracy of some locations.

CAMP BONNEVILLE

Non-Urban Culture Features are defined as all man-made features existing on a reservation outside of the defined cantonment area(s) that could have an effect, either positively or negatively, on military training and operations. Twenty-three (23) non-urban culture features located outside the cantonment areas but within reservation boundaries are listed and described in Table L-2, below. Feature locations are plotted on the Camp Bonneville map provided as an inset on the accompanying Fort Lewis graphic. Locations are keyed by map numbers to the information provided in the table. A majority of the features are buildings and revetments.

CAMP BONNEVILLE (continued)

TABLE L-2, NON-URBAN CULTURE FEATURES[1]

MAP NUMBER	GRID REFERENCE[2]	DESCRIPTION
1	45946046	Building; General Storehouse, 1 story, 35.7 m^2 (384 ft^2), concrete foundation, woodframe walls, composition roof
2	46156031	Pumping Station; 1 story, 15.6 m^2 (168 ft^2), concrete foundation, woodframe walls, composition roof
3	45416029	Water Storage Tank; 75,000 gal. capacity, concrete foundation, concrete walls, metal roof
4	46356023	Building; General Storehouse, 1 story, 50.2 m^2 (540 ft^2), concrete foundation, woodframe walls, composition and metal roof
5	46406015	Building; General Storehouse, 1 story, 105.5 m^2 (1,136 ft^2), concrete foundation, woodframe walls, composition roof
6	46376013	Revetment; length 54 m (177 ft). Average height of revetments unknown.
7	46306010	Revetment; length 86 m (283 ft)
8	46206010	Revetment; length 90 m (295 ft)
9	46106008	Revetment; length 54 m (177 ft)
10	45976005	Revetment; length 111.4 m (366 ft)
11	45485976	Building; Latrine, 1 story, 22.3 m^2 (240 ft^2), concrete foundation, woodframe walls, composition roof
12	45675977	Building; General Storehouse, 1 story, 44.6 m^2 (480 ft^2), concrete foundation, woodframe walls, composition roof
13	44465985	Water Storage Tank; 10,000 gal. capacity, concrete foundation, concrete walls, wood roof
14	44475986	Pumping Station; 1 story, 15.6 m^2 (168 ft^2), concrete foundation, woodframe walls, composition roof
15	45185917	Revetment; length 46.8 m (153 ft), height 3 m (10 ft)
16	44135930	Building; Sentry Station, height 2.4 m (8 ft), 1.5 m^2 (16 ft^2), wood foundation, wood structure, movable, not in use
17	45906010	Observation Tower; height 7.6 m (25 ft)
18	45255847	Wall; Live Hand Grenade Range, concrete, height 2.1 m (7 ft), length 22.9 m (75 ft), width 25.4 cm (10 in.)
19	45265847	2 Bunkers; standard grenade bunkers with safety sump in bottom, 9.29 m^2 (100 ft^2)
20	45105830	Building
21	45155824	Range Control Tower; 97.5 m^2 (320 ft^2), height (rear) 2.1 m (7 ft), (front) 4.6 m (15 ft)
22	45175825	Firing Line Shed; length 93.9 m (308 ft), woodframe, metal roof
23	45926023	3 Buildings; Fixed Ammo Magazines, 1 story, concrete foundation, concrete walls, concrete roof, 1 –4.6 m^2 (49 ft^2), 1–2.3 m^2 (25 ft^2), 1–9.3 m^2 (100 ft^2). Fenced; standard 1.8 m (6 ft) cyclone, with 0.3 m (1 ft) 3 strand barbed wire at the top, 39.6 m × 12.2 m × 38.1 m × 10.7 m (130 ft × 40 ft × 125 ft × 35 ft)

[1]Status as of November 1976.
[2]Eight digit grid reference coordinates were used to increase the accuracy of some locations.

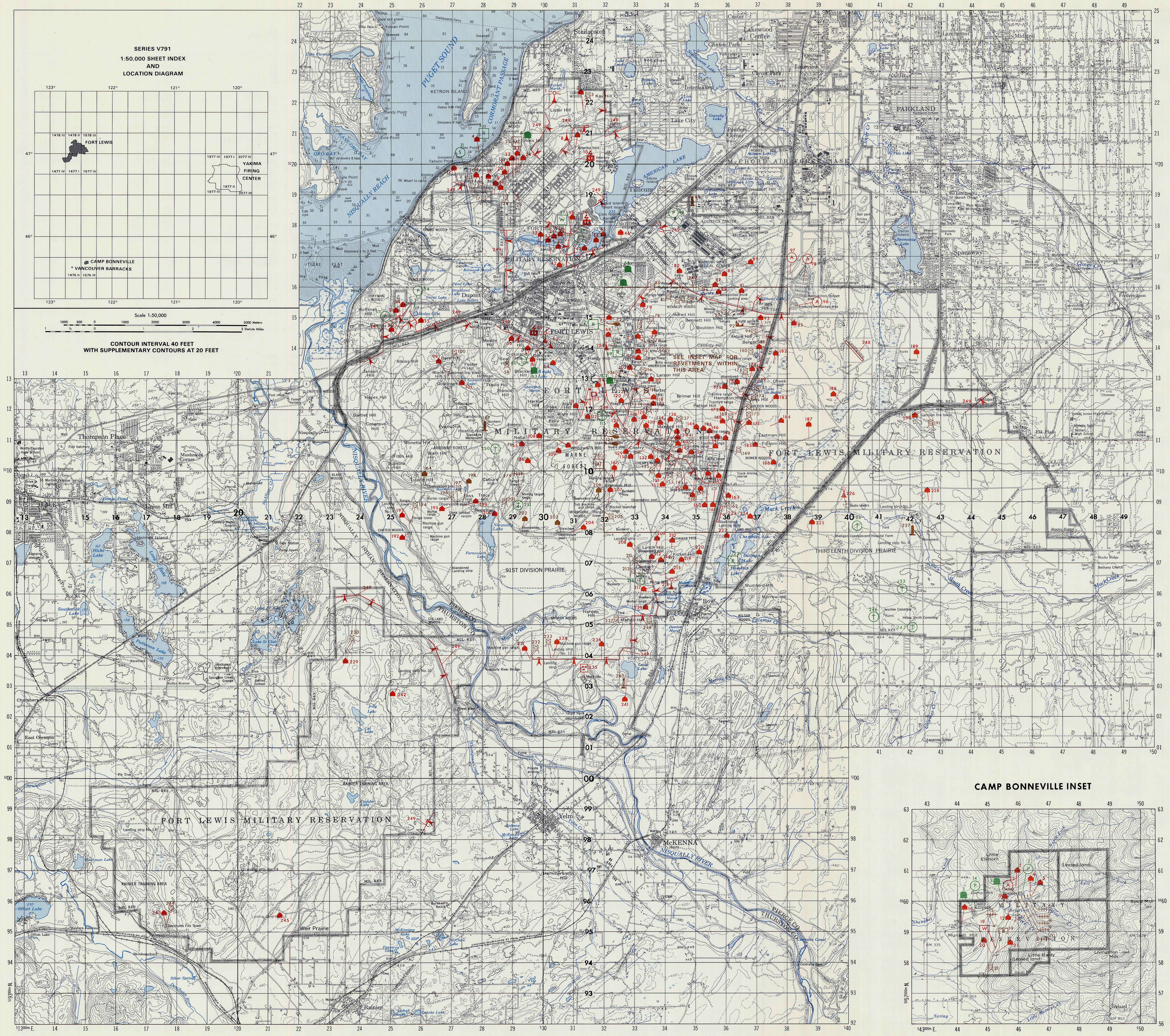
YAKIMA FIRING CENTER

Non-Urban Culture Features are defined as all man-made features existing on a reservation outside of the defined cantonment area(s) that could have an effect, either positively or negatively, on military training and operations. Sixty-six (66) non-urban culture features located outside the cantonment area but within the Yakima Firing Center reservation boundary are listed and described in Table L-3, below. Locations are plotted on the accompanying map and are keyed to the table by map number. Most of the identified features are building structures, many of which are of a temporary nature.

TABLE L-3, NON-URBAN CULTURE FEATURES[1]

MAP NUMBER	GRID REFERENCE[2]	DESCRIPTION
1	06598283	Building; General Purpose Administration, 1 story, 74.3 m^2 (800 ft^2), concrete foundation, metal walls, metal roof
2	06958273	Ammunition Storage Pad; 49.3 m^2 (531 ft^2), concrete
3	07068270	Building[3]; Tent Slab, 1 story, 49.1 m^2 (528 ft^2), concrete
4	07478281	Building[3]; Tent Slab, 1 story, 49.1 m^2 (528 ft^2), concrete
5	08708285	Moving Target Track
6	09408320	Building; Target Storage Shed, 1 story, 25.9 m^2 (279 ft^2), concrete slab
7	18208160	Observation Tower; 1 story, 5.6 m^2 (60 ft^2), wood foundation, wood frame walls, composition roof
8	06657915	Building
9	07007782	Observation Tower; 1 story, 5.6 m^2 (60 ft^2), wood foundation, wood frame walls, composition roof
10	08397754	Observation Tower; 1 story, 5.6 m^2 (60 ft^2), wood foundation, wood frame walls, composition roof
11	09467693	Observation Tower; 1 story, 5.6 m^2 (60 ft^2), wood foundation, wood frame walls, composition roof
12	10507610	Observation Tower; 1 story, 5.6 m^2 (60 ft^2), wood foundation, wood frame walls, composition roof
13	00007576	Abandoned Airstrip; Poverty Flats Airstrip, length 676 m (2200 ft), width 47 m (135 ft), dirt surface
14	04587590	Selah Water Well; 40 gpm, 3.3 m^2 (36 ft^2), concrete slab
15	16507520	Observation Tower; 1 story, 5.6 m^2 (60 ft^2), wood foundation, wood frame walls, composition roof
16	03837465	Building[3]; Tent Slab, 49.1 m^2 (528 ft^2), concrete
17	04007469	Building; General Purpose Administration. 1 story, 74.3 m^2 (800 ft^2), concrete foundation, steel walls, steel roof
18	04057455	Building; Ammunition Loading and Unloading Dock, 1 story, 33.4 m^2 (360 ft^2), concrete foundation, concrete walls
19	04257480	Observation Tower; 1 story, 3.3 m^2 (36 ft^2), concrete foundation, steel walls, steel roof
20	04557521	Building; Range House, 1 story, 13.4 m^2 (144 ft^2), concrete foundation, concrete walls, concrete roof
21	03957433	Ammunition Storage Pad; 49.3 m^2 (531 ft^2), concrete
22	04727470	Observation Tower; 1 story, 3.3 m^2 (36 ft^2), concrete foundation, steel walls, steel roof
23	07507440	Abandoned Airstrip; Paradise Valley Airstrip, dirt surface
24	00557279	Building; Radio Transmitter Building, 1 story, 4.5 m^2 (48 ft^2), concrete foundation, metal walls, metal roof
25	01067270	Building; General Storehouse, 1 story, 74.3 m^2 (800 ft^2), concrete foundation, steel walls, steel roof
26	01307290	5 Revetments
27	01527329	Radio Tower; height, 27.4 m (90 ft), with 8.5 m (28 ft) high antenna
28	02157300	Building; Target Storage, 1 story, 17.8 m^2 (192 ft^2), wood foundation, wood frame walls, built-up roof
29	02417264	Building; General Storehouse, 1 story, 29.7 m^2 (320 ft^2), concrete foundation, wood frame walls, wood roof
30	03237250	Building; Range House, 1 story, 199.7 m^2 (2,150 ft^2), concrete foundation, wood frame walls, composition roof
31	03207235	Building
32	03257221	Building
33	03457235	Building[3]; Tent Slab, 49.1 m^2 (528 ft^2), concrete
34	04167285	Building; Motor Shelter, 1 story, 36.3 m^2 (391 ft^2), concrete foundation, wood frame walls, composition roof
35	04357264	Building; 1 story, 9.3 m^2 (100 ft^2), concrete foundation, concrete walls, concrete roof
36	04437234	Observation Tower; 1 story, 3.3 m^2 (36 ft^2), concrete foundation, steel walls, wood roof
37	12907170	Building; Range House, 1 story, 13.4 m^2 (144 ft^2), concrete foundation, concrete walls, concrete roof
38	13037139	Building; Range House, 1 story, 13.4 m^2 (144 ft^2), concrete foundation, concrete walls, concrete roof
39	20867165	Building; Radio Transmitting, 1 story, 7.9 m^2 (85 ft^2), concrete foundation, concrete masonry unit walls, built-up roof
40	20957165	Radio Tower; height, 12.2 m (40 ft), with a 8.5 m (28 ft) antenna
41	20967164	Fuel Point; 1100 gallon propane gas tank, 3.1 m × 3.1 m × 3.1 m (10 ft × 10 ft × 10 ft)
42	03407110	Ammunition Storage Pad; 49.3 m^2 (531 ft^2), concrete
43	03507085	Building[3]; Tent Slab, 1 story, 49.1 m^2 (528 ft^2), concrete
44	03567095	Building[3]; Tent Slab, 1 story 49.1 m^2 (528 ft^2), concrete
45	03607065	Building[3]; Tent Slab, 1 story, 49.1 m^2 (528 ft^2), concrete
46	03707100	Sync Ramp; 1 story, 60.2 m^2 (648 ft^2), concrete
47	07807005	Abandoned Airstrip; Cold Creek Airstrip, dirt surface
48	11116980	Building[3]; Tent Slab, 1 story, 49.1 m^2 (528 ft^2), concrete
49	11276996	Building[3]; Tent Slab, 1 story, 49.1 m^2 (528 ft^2), concrete
50	11837007	Building; General Purpose Administration, 1 story, 74.3 m^2 (800 ft^2), concrete foundation, steel walls, steel roof
51	12037020	Ammunition Storage Pad; 49.3 m^2 (531 ft^2), concrete
52	12107015	Building; Ammunition Loading and Unloading Dock, 1 story, 33.4 m^2 (360 ft^2), concrete foundation, concrete walls
53	12476985	Observation Tower; 1 story, 3.3 m^2 (36 ft^2), concrete foundation, steel walls, wood roof
54	16396840	Building; General Purpose Warehouse, 1 story, 199.7 m^2 (2,150 ft^2), concrete foundation, wood frame walls, built-up roof
55	25206690	Abandoned Airstrip; Coffin Ranch Airstrip, dirt surface
56	25926689	Building; Target Machine House, 1 story, 27.8 m^2 (299 ft^2), wood foundation, wood frame walls, composition roof
57	27056660	Building; Generator Pad, 1 story, 11.2 m^2 (120 ft^2), concrete slab
58	27196664	Building; Root Cellar, 1 story, 22.1 m^2 (238 ft^2), concrete foundation, concrete walls, wood frame roof
59	27256655	Building; Root Cellar, 1 story, 22.1 m^2 (238 ft^2), concrete foundation, wood frame walls, composition roof
60	27406664	Building; Generator Pad, 1 story, 9.3 m^2 (100 ft^2), concrete slab
61	05566245	Abandoned Airstrip; Washout Gulch Airstrip, dirt surface
62	12356313	Abandoned Airstrip
63	24615951	Ruins
64	From 95007199 To 03307235	Electric power lines; 12.47 KV, cross phase, class 4, on wooden poles spaced approximately 40 m (131.2 ft) apart, height, 12.2 m (40 ft).
65		Underground Telephone Cables:
	From 95007199 To 03307235	Main cable
	From 03307235 To 04567600	Single cable to Selah Airstrip
	From 03307235 To 22556655	Two (2) cables
	From 22556655 To 26856650	Single cable
66		Overhead Telephone Cable:
	From 26856650 To 77556435	On wooden poles spaced approximately 53 m (175 ft) apart, height, 7.6 m (25 ft).

[1]Status as of November 1976.
[2]Eight digit grid reference coordinates were used to increase the accuracy of some locations.
[3]Tent type structure, erected part or all of the year.



FORT LEWIS, WASHINGTON

(Including Camp Bonneville, Vancouver Barracks and Yakima Firing Center)

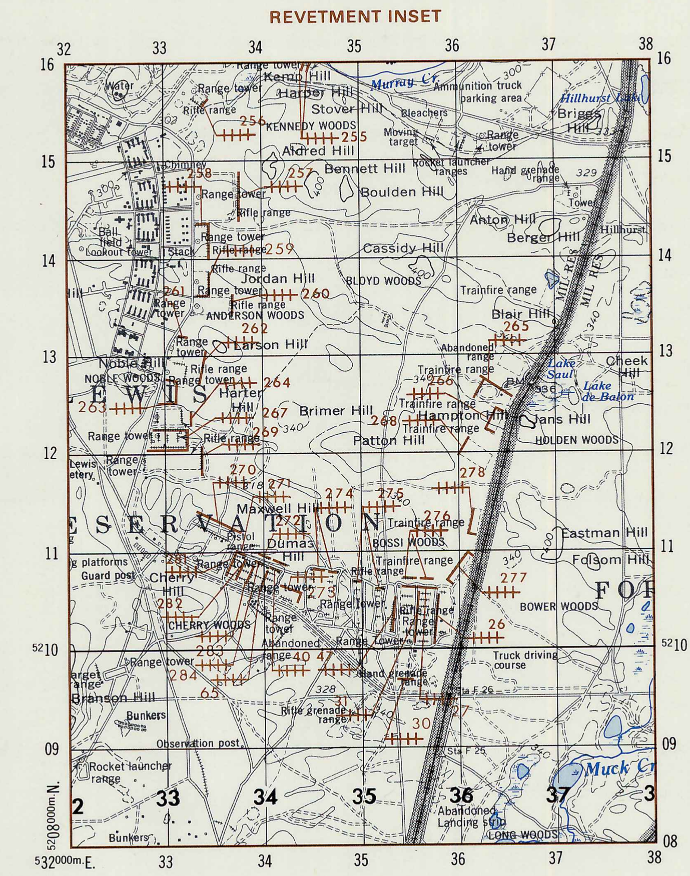
TERRAIN ANALYSIS

NON-URBAN CULTURE FEATURES

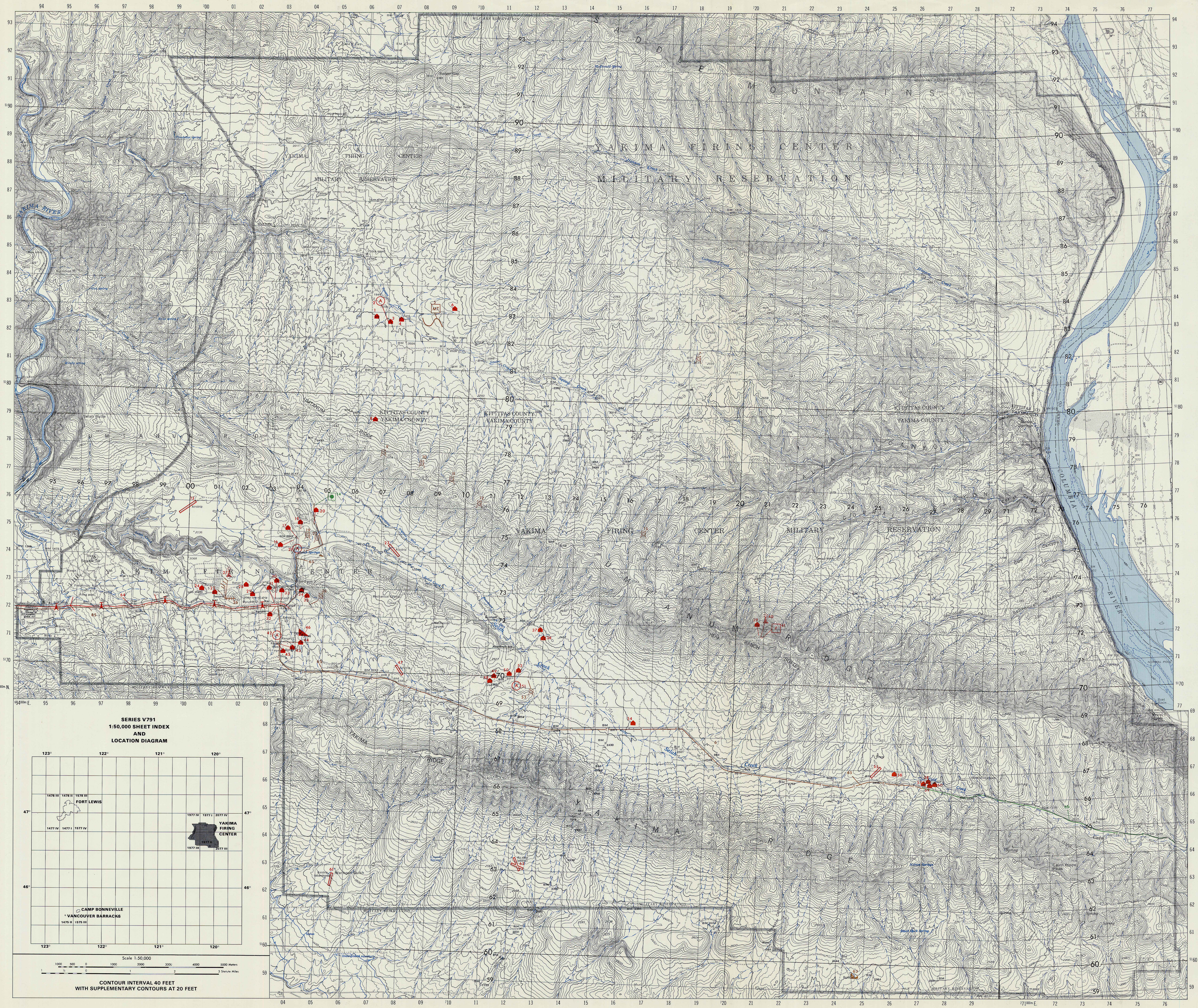
FORT LEWIS - CAMP BONNEVILLE

- Building
- Observation Tower
- Flag Pole
- Rappelling Tower
- Beacon
- Antenna Tower
- Radio Tower
- Recreation Area
- Water Storage Tank
- Pumping Station
- Water Treatment Facility
- Sewage Treatment Facility
- Electric Substation
- Electric Power Line
- Monument
- Cemetery
- Helicopter Mock-up
- Aircraft Mock-up
- Mock City
- Ammunition Storage Facility
- Observation Post
- Abandoned Airstrip
- Ruins
- Moving Target Track
- Revetment
- Bunkers
- Wall

Number on map refers to entry in table



Prepared by the Terrain Analysis Center, U. S. Army Engineer Topographic Laboratories, Fort Belvoir, Virginia, March 1977. Cartographic and Reproduction Support by the Defense Mapping Agency Hydrographic/Topographic Center, Washington, D. C. December 1978.



FORT LEWIS, WASHINGTON

(Including Camp Bonneville, Vancouver Barracks and Yakima Firing Center)

TERRAIN ANALYSIS

NON-URBAN CULTURE FEATURES

YAKIMA FIRING CENTER

- Building
- Observation Tower
- Radio Tower
- Ammunition Storage Facility
- Fuel Point
- Ruins
- Water Well
- Revetment
- Moving Target Track
- Abandoned Airstrip
- Ramp
- Electric Power Line
- Overhead Telephone Cable
- Underground Telephone Cable

Number refers to entry in table.

Prepared by the Terrain Analysis Center, U. S. Army Engineer Topographic Laboratories, Fort Belvoir, Virginia, March 1977. Cartographic and Reproduction Support by the Defense Mapping Agency Hydrographic/Topographic Center, Washington, D. C. December 1978.

III. OFF-POST FEATURES, FORT LEWIS

Off-Post Features covered by this study are limited to airfields and urban areas within a 50-mile radius and ports within a 100-mile radius of Fort Lewis. Locations are provided on the accompanying map. AIRFIELDS: There are four airfields within a 50-mile radius of Fort Lewis that have the capability of handling cargo-troop transport aircraft equivalent to the C-130 Hercules or larger. Three of the fields are civil and one military. Detailed information concerning each of the fields is provided in Table III-A. All of the airfields are relatively close to Fort Lewis. Boeing Field/King County International, located 54.7 kilometers (34 miles) northeast, is the most distant; McChord Air Force Base, located 9.6 kilometers (6 miles) also northeast of the installation, the closest. All fields are easily accessible by Interstate 5 and by rail. URBAN AREAS: There are 35 cities with populations greater than 2,500 within a 50-mile radius of Fort Lewis. All are located in the State of Washington and all are incorporated places except Parkland and Spanaway. The range of population runs from 2,530 to 490,000. Table III-B provides data for each of the cities in terms of population; housing availability; educational, medical and recreation facilities; and public utilities. PORTS: Selected data for ports located within an approximate 100-mile radius of Fort Lewis are provided in Table III-C. All except one are civil commercial. The exception, the Puget Sound Naval Shipyard, is owned and operated by the US Navy. Five of the 12 ports are located on Puget Sound, four on the Columbia River, two on the Straits of Juan De Fuca and one on the Washington Coast. The ports of Tacoma and Olympia are the nearest to Fort Lewis; Portland, Vancouver and Anacortes, the most distant. Olympia, Tacoma, Seattle and Everett, because of their locations with respect to rail and road connections, are the most accessible. All the ports can handle deep-draft ocean-going vessels; all have some capability to handle shipments of troops and equipment.

TABLE III-A, AIRFIELDS

NAME: LOCATION: TYPE: AND CLASSIFICATION	ELEVATION AND STATUS[1]	RUNWAY DESCRIPTION[2]	TAXIWAY, PARKING APRON, AND HARDSTAND AREA DESCRIPTION	BUILDING DESCRIPTION	POL FACILITIES[3]	NAVIGATIONAL AIDS	REMARKS
Name: Seattle-Tacoma International. Location: 47°27'N, 122°18'W. Type: Airfield. Classification: Civil.	Elevations: Runway 130 m (428 ft); top of control tower 148 m (485 ft). Status: Operational.	Longest Runway: 3,627 m (11,900 ft) long; 46 m (150 ft) wide; azimuth, 160°–340°; weight bearing capacity—S160, T200, ST175, TT320; concrete surface in good condition. Other Runways: 2,872 m (9,424 ft) long; 46 m (150 ft) wide; azimuth, 160°–340°; weight bearing capacity, same as for longest runway; concrete surface in good condition.	Taxiways: Three, with widths of 30.5 m (100 ft), 45.7 m (150 ft), and 30.5 m (100 ft); surface material—concrete, concrete/asphalt, and concrete/asphalt respectively; weight bearing capacity—TT350 for each. Parking Aprons, and Hardstand Areas: Total area approximately 836,100m² (9,000,000 ft²); weight bearing capacity—TT350; concrete surface material.	Hangars: Four. Dimensions: 106.7 × 137.2 m (350 × 450 ft); 85.3 × 42.7 m (280 × 140 ft); 36.6 × 79.2 m (120 × 260 ft); 18.3 × 40.8 m (60 × 134 ft). Maintenance Facilities: Two.	Type of Fuel: No contract fuels. Commercial aviation fuel 80/87, 100/130, 115/145, jet fuel ASTM type A, jet fuel ASTM type A-1 (W/O FS-11)[4]	Communications and Navigation: Control tower, Flight Service Station Seattle (direct line contact), automatic terminal information service, continuous automatic transcribed weather broadcasts service, VORTAC (for aircraft bearing and distance), VHF/DF (very high frequency direction finder), airport surveillance radar, instrument landing system (ILS). Lighting: Rotating beacon, approach lights, high intensity runway lights, high intensity approach lights, sequenced flashing lights, visual approach slope indicator systems, and runway centerline lights.	Aerodrome is partially covered by the USAF NOTAM system, but does not maintain a military NOTAM file. For complete aerodrome information, civil NOTAMS must also be consulted.
Name: Renton Municipal. Location: 47°30'N, 122°13'W. Type: Airfield. Classification: Civil.	Elevation: Runway 9 m (29 ft). Status: Operational.	Runway: 1,640 m (5,379 ft) long; 61 m (200 ft) wide; azimuth, 150°–330°; weight bearing capacity—S100, T135, ST171, TT225; asphaltic concrete surface in good condition.	Taxiways: Two, with widths of 22.9 m (75 ft); weight bearing capacity—TT225 each; asphalt surface. Parking Aprons, and Hardstand Areas: Total area approximately 123,092 m² (1,325,000 ft²); asphalt surfaces.	Hangars: Seven, plus sixty-nine T-Hangars. Dimensions unknown.	Types of Fuel: Commercial aviation fuels 80/87, 100/130, and jet fuel ASTM type B[5]. No contract fuel.	Communications: Control tower, Flight Service Station Seattle. Lighting: Rotating beacon, runway lights, visual approach slope indicator systems, runway and identifier lights (REIL) (threshold strobe lights).	Aerodrome is only partially covered by the USAF NOTAM system, but does not maintain a military NOTAM file. For complete aerodrome information civil NOTAMS must also be consulted.
Name: Boeing Field/King County International. Location: 47°32'N, 122°18'W. Type: Airfield. Classification: Civil.	Elevations: Runway 5 m (17 ft); top of control tower 34.1 m (112 ft). Status: Operational.	Runway: 3,048 m (10,000 ft) long; 61 m (200 ft) wide; azimuth, 130°—310°; weight bearing capacity—S100, T125, ST159, TT215; concrete surface in good condition. (see Remarks)	Taxiways: Two, with widths of 60.1 m (200 ft) and 24.3 m 80 ft); weight bearing capacities—TT290; surface material is concrete/asphalt. Parking Aprons and Hardstand Areas: Total area approximately 650,300 m² (7,000,000 ft²); weight bearing capacity—TT290; asphalt/concrete surfaces.	Hangars: Two. Dimensions: 60.9 × 237.7 × 38. 1 m (200 × 780 × 125 ft) and 57.9 × 76.2 m (190 × 250 ft); plus 125 T-hangars, and 25 other hangars available for transient aircraft.	Types of Fuel: US aviation fuel (MIL SPECS) 100/130; commercial aviation fuels 80/87, 100/130, jet fuel ASTM type A, and jet fuel ASTM type A without icing inhibitors; US aviation oils (MIL SPECS) 1100 (dispersant) reciprocating engine oil (MIL-L-22851) (Type II). Galvin Flying Service, Inc., provides contract fuel.	Communications and Navigation: Control tower, Flight Service Station Seattle (direct line contact); instrument landing system (ILS). Lighting: Rotating beacon, runway lights, high intensity runway lights, high intensity approach lights, sequenced flashing lights, runway end identifier lights (REIL) (threshold strobe lights).	Aerodrome is only partially covered by the USAF NOTAM system, but does not maintain a military NOTAM file. For complete aerodrome information, civil NOTAMS must also be consulted. According to "Business Economic Indicators, 1975," Boeing is capable of handling any size aircraft.
Name: McChord Air Force Base. Location: 47°09'N, 122°29'W. Type: Airfield. Classification: Civil.	Elevation: Runway 98 m (322 ft). Status: Operational.	Runway: 3,048 m (10,000 ft) long; 46 m (150 ft) wide; azimuth, 160°–340°; weight bearing capacity—S155, T220, ST175, TT390, TDT800; asphalt surface in good condition.	Taxiways: Four, with widths of 22.9 m (75 ft), 45.7 m (150 ft), 30.5 m (100 ft), and 22.9 m (75 ft); surface materials are concrete/asphalt, asphalt, and concrete/asphalt respectively; weight bearing capacity—TT550. Parking Aprons, and Hardstand Areas: Total area approximately 608,514 m² (6,550,200 ft²); weight bearing capacity—TT550; concrete surfaces except for one auxiliary parking apron with asphalt surface.	Hangars: Four. Dimensions: each 74 × 68 × 17.7 m (243 × 223 × 58 ft); plus, 4 nose docks, each 60.3 × 25.5 × 9.4 m (198 × 83.6 × 31 ft); 2 nose docks, each 45.7 × 19.2 × 8.2 m (150 × 63 × 27 ft); and, one nose dock 77.5 × 17.2 × 9.7 m (254.4 × 56.5 × 32 ft). Maintenance Facilities: Eight.	Type of Fuel: US aviation fuel (MIL SPECS) 115/145[6], JP-4, 1100 (dispersant) reciprocating engine oil (MIL-L-22851) (Type II), 1010 jet engine oil (MIL-L-6081). Storage and Dispensing Facilities: Single point refueling. Services and Equipment: Spectrometric oil analysis program, air compressors rated 3,000 PSI or more, low and high pressure oxygen servicing, and liquid oxygen servicing. All the above for turboprop and turboshaft engines.	Communications and Navigation: Control tower, Flight Service Station Seattle (direct line contact), single frequency approach station, continuous automatic transcribed weather broadcasts service, VORTAC (for aircraft bearing and distance, no NOTAM preventive maintenance schedule), airport surveillance radar, precision approach radar, instrument landing system (ILS), and ground control approach system (GCA). Lighting: Rotating beacon, high intensity runway lights, high intensity approach lights, sequenced flashing lights, visual approach slope indicator systems, runway centerline lights.	Aerodrome is fully covered by the USAF NOTAM system and maintains a military NOTAM file.

[1]Runway elevation is at the highest point on the runway.
[2]NOTE: Runway weight bearing capacity in pounds (gross weight of aircraft) is determined by adding 000 to figure following S, T, ST, TT, TDT. Runway weight bearing capacity given is for unlimited operations. Aircraft weight higher than given requires prior permission from aerodrome controlling authority.
S—Runway weight bearing capacity for aircraft with single-wheel type landing gear (C-47, F-100).
T—Runway weight bearing capacity for aircraft with twin-wheel type landing gear (C-9A).
ST—Runway weight bearing capacity for aircraft with single-tandem landing gear (C-130).
TT—Runway weight bearing capacity for aircraft with twin-tandem type (includes quadricycle) landing gear (B-52, C-135).
TDT—Runway weight bearing capacity for aircraft with twin-delta tandem landing gear (C-5).
For further information, see DOD Flight Information Publication, (enroute IFR-Supplement United States).
[3]ASTM—Commercial jet fuels conform to specifications established by the American Society for Testing Materials.
[4]FS-11—icing inhibitor.
[5]Jet fuel ASTM type B is a commercial fuel similar to MIL JP-4; may or may not contain icing inhibitor.
[6]Limited quantities available. Prior permission required.

TABLE III-B, URBAN AREAS[1]

NAME AND LOCATION	POPULATION	HOUSING AVAILABILITY	EDUCATION FACILITIES[2]	MEDICAL FACILITIES	RECREATION FACILITIES	PUBLIC UTILITIES[3]	REMARKS
Name: Auburn. Location: 47°19'N, 122°13'W; King County, Washington	Census 1970: 21,817. Estimated 1975: 22,300. Projected 1980: 26,500	Houses: Total Number: 5,341; Number of Rentals: 1,092 (1970); Average Monthly Rent: $275; Percent Rental Vacancies: 1.2%; New House Starts: 155; Average Number of Sales per Year: No data; Average Sale Price: $40,000. Apartments: Total Number: 1,998; Average Monthly Rent: $185; Average Percent Vacant: 2.7%	Elementary Schools: Number of Schools: 9 (plus 1 parochial school); Enrollment Capacity: 4,959; 1975 Enrollment: 4,239; 1980 Projection: 4,012; Location: 7 in city of Auburn and 2 in King County. Jr. High Schools: Number of Schools: 2; Enrollment Capacity: 1,725; 1975 Enrollment: 2,038; 1980 Projection: 2,123. Secondary Schools: Number of Schools: 1; Enrollment Capacity: 2,880; 1975 Enrollment: 1,683; 1980 Projection: 2,096. Colleges: Number of Schools: 1 (Green River Community College); 1974 Enrollment: 6,747	Doctors: Total Number: 31; Doctor/Population Ratio: 1/720. Dentists: Total Number: 27; Dentist/Population Ratio: 1/826. Hospitals: Total Number: 1; Total Beds: 90; Intensive Care Units: 1; total beds: 3; Coronary Care Units: 1; total beds: 2; Planned Expansion: Currently expanding to 120 beds, including 1 each for intensive and coronary care units	Parks: 17. Athletic Fields: 8. Tennis Courts: 6. Golf Courses: 1	Electric Power: Source: Puget Sound Power and Light Company; Type: Hydroelectric; Future Plants: No data. Sewage Disposal: Metro[4]. Heating Fuels: Types Available: Oil, gas; Expansion Plans: No data. Water Supply: Source: Wells and springs; Adequacy of Service: Adequate to year 2000+; Expansion Plans: None	Parochial school not included in figures.

III. OFF-POST FEATURES, FORT LEWIS (continued)

TABLE III-B, URBAN AREAS[1] (continued)

NAME AND LOCATION	POPULATION	HOUSING AVAILABILITY	EDUCATION FACILITIES[2]	MEDICAL FACILITIES	RECREATION FACILITIES	PUBLIC UTILITIES[3]	REMARKS
Name: Bellevue Location: 47°37'N, 122°12'W; King County, Washington	Census 1970: 61,102 Estimated 1975: 64,400 Projected 1980: No data	Houses: Total Number: 13,933 (1970) Number of Rentals: 1,454 (1970) Average Monthly Rent: No data Percent Rental Vacancies: No data New House Starts: No data Average Number of Sales per Year: No data Average Sale Price: $33,000 (1970) Apartments: Total Number: 3,615 (1970) Average Monthly Rent: No data Average Percent Vacant: No data	Elementary Schools: Number of Schools: 24 Enrollment Capacity: No data 1974 Enrollment: 10,387 1980 Projection: No data Jr. High Schools: Number of Schools: 8 Enrollment Capacity: No data 1974 Enrollment: 5,691 1980 Projection: No data Secondary Schools: Number of Schools: 4 Enrollment Capacity: No data 1974 Enrollment: 5,745 1980 Projection: No data Colleges: Number of Schools: 1 (Bellevue Community College) 1974 Enrollment: 6,690	Doctors: Total Number: 125 Doctor/Population Ratio: 1/515 Dentists: Total Number: 96 Dentist/Population Ratio: 1/708 Hospitals: Total Number: 1 Total Beds: No data Planned Expansion: No data	No data	Electric Power: Source: Puget Sound Power and Light Company Type: Hydroelectric Future Plants: No data Sewage Disposal: Metro[4] Heating Fuels: Natural gas Water Supply: Source: Seattle Water Department Adequacy of Service: Good Expansion Plans: No data	Plus 7 parochial and private schools with total enrollment of 2,039.
Name: Bothell Location: 47°45'N, 122°12'W; King County, Washington	Census 1970: 4,883 Estimated 1975: 5,755 Projected 1980: 7,000	Houses: Total Number: 1,377 Number of Rentals: No data Average Monthly Rent: No data Percent Rental Vacancies: 4.6% New House Starts: 87 Average Number of Sales per Year: No data Average Sale Price: $40,000 Apartments: Total Number: 424 Average Monthly Rent: No data Average Percent Vacant: 7.3%	Elementary Schools: Number of Schools: 2 Enrollment Capacity: No data 1975 Enrollment: No data Jr. High Schools: Number of Schools: None Secondary Schools: Number of Schools: 1 Enrollment Capacity: No data 1975 Enrollment: No data	Doctors: Total Number: 12 Doctor/Population Ratio: 1/480 Dentists: Total Number: 7 Dentist/Population Ratio: 1/822 Hospitals Total Number: None	Parks: 6 Athletic Fields: 2 Tennis Courts: 6 Golf Courses: 1	Electric Power: Source: Puget Sound Power and Light Company Type: Hydroelectric Future Plants: Nuclear plants Sewage Disposal: Metro[4] Heating Fuels: Types Available: Oil, natural gas, wood Expansion Plans: No data Water Supply: Source: Tolt River Adequacy of Service: Adequate Expansion Plans: No data	
Name: Bremerton Location: 47°37'N, 122°37'W; Kitsap County, Washington	Census 1970: 35,307 Census 1975: 37,132 Projected 1980: 48,000 (includes population increase to support the expanding TRIDENT program)	Houses: Total Number: 8,101 Number of Rentals: 1,935 Average Monthly Rent: No data Percent Rental Vacancies: 2.9% New House Starts: 57 Average Number of Sales per Year: No data Average Sale Price: No data Apartments: Total Number: 4,687 Average Monthly Rent: No data Average percent Vacant: 4.8%	Elementary Schools: Number of Schools: 11 (9 in use) Enrollment Capacity: No data 1975 Enrollment: 3,430 1980 Projectipn: No data Jr. High Schools: Number of Schools: 1 Enrollment Capacity: No data 1975 Enrollment: 1,071 1980 Projection: No data Secondary Schools: Number of Schools: 2 Enrollment Capacity: No data 1975 Enrollment: 2,230 1980 Projection: No data Colleges: Number of Schools: 1 (Olympic Community College) 1974 Enrollment: 7,050	Doctors: Total Number: 89 Doctor/Population Ratio: 1/417 Dentists: Total Number: 27 Dentist/Population Ratio: 1/1,375 Hospitals: Total Number: 1 Total Beds: 210 Intensive Care Units: 1; total beds: 9 Coronary Care Units: Same facilities as for intensive care. Planned Expansion: Expand to 228 beds ASAP, with 10 intensive care beds and 8 cardiac beds in two separate units	Parks: 34 Athletic Fields: 12 Tennis Courts: 19 Golf Courses: 3	Electric Power: Source: Puget Sound Power and Light Company Type: 7 hydroelectric and 2 thermoelectric plants Future Plants: In 1982 will tie into Skagit Nuclear Plant Sewage Disposal: Number of Plants: 2 Type of Treatment: Primary Flow Capacity, GPD: 6,480,000 Actual Flow, GPD: 7,320,000 Heating Fuels: Types Available: Natural gas, oil Expansion Plans: No data Water Supply: Source: Union River wells at Anderson Creek Adequacy of Service: Good for next 10 years Expansion Plans: 2 new wells in north end, 2 new reservoirs in north end, 1 new reservoir in Jackson Park, and 1 new water pipeline	TRIDENT program is having a significant impact on the Bremerton area and Kitsap County.
Name: Buckley Location: 47°09'N, 122°01'W; Pierce County, Washington	Census 1970: 3,446 Estimated 1975: 3,120 Projected 1980: 3,400	Houses: Total Number: 596 (1970) Number of Rentals: No data Average Monthly Rent: $125 Percent Rental Vacancies: No data New House Starts: No data Average Number of Sales per Year: No data Average Sale Price: No data Apartments: Total Number: 45 units Average Monthly Rent: $125 Average Percent Vacant: None	Elementary Schools: Number of Schools: 1 Enrollment Capacity: No data 1975 Enrollment: No data Jr. High Schools: Number of Schools 1 Enrollment Capacity: No data 1975 Enrollment: No data Secondary Schools: Number of Schools: 1 Enrollment Capacity: No data 1975 Enrollment: No data	Doctors: Total Number: 1 Doctor/Population Ratio: 1/3,120 Dentists: Total Number: 1 Dentist/Population Ratio: 1/3120 Hospitals: Total Number: None	Parks: 2 Athletic Fields: No data Tennis Courts: No data Golf Courses: None	Electric Power: Source: Puget Sound Power and Light Company Type: Hydroelectric Future Plants: No data Sewage Disposal: Number of Plants: 1 Type of Treatment: No data Flow Capacity, GPD: No data Actual Flow, GPD: No data Heating Fuels: Types Available: Natural gas Expansion Plans: No data Water Supply: Source: South Prairie Creek Adequacy of Service: No data Expansion Plans: No data	
Name: Centralia Location: 46°43'N, 122°57'W; Lewis County, Washington	Census 1970: 10,054 Estimated 1975: 10,582 Projected 1980: 11,000	Houses: Total Number: 4,478 Number of Rentals: 675 (1970) Average Monthly Rent: $200 Percent Rental Vacancies: 3.9% New House Starts: 62 Average Number of Sales per Year: No data Average Sale Price: $25,000 Apartments: Total Number: 624 (1970) Average Monthly Rent: $175 Average Percent Vacant: No data	Elementary Schools: Number of Schools: 5 Enrollment Capacity: 1,650 1975 Enrollment: 1,544 1980 Projection: 1,700 Jr. High Schools: Number of Schools: 1 Enrollment Capacity: 700 1975 Enrollment: 577 1980 Projection: 600 Secondary Schools: Number of Schools: 1 Enrollment Capacity: 1,200 1975 Enrollment: 1,093 1980 Projection: 1,150 Colleges: Number of Schools: 1 (Centralia Community College) 1975 Enrollment: 3,928	Doctors: Total Number: 17 Doctor/Population Ratio: 1/623 Dentists: Total Number: 12 Dentist/Population Ratio: 1/882 Hospitals: Total Number: 1 Total Beds: 47 Intensive Care Units: 1; total beds: 3 Coronary Care Units: Same facilities as for intensive care Planned Expansion: Increase by 50%; no date set	Parks: 6 Athletic Fields: 9 Tennis Courts: 3 Golf Courses: 1	Electric Power: Source: Centralia City Light Company Type: Hydroelectric Future Plants: Plan to purchase from Bonneville Power Administration Sewage Disposal: Number of Plants: 1 Type of Treatment: Trickling filter Flow Capacity, GPD: 2,800,000 Actual Flow, GPD: 3,300,000 Heating Fuels: Types Available: Oil, gas, coal Expansion Plans: No data Water Supply: Source: River and wells Adequacy of Service: Excellent Expansion Plans: Additional wells under contract	

TABLE III-B, URBAN AREAS[1] (continued)

NAME AND LOCATION	POPULATION	HOUSING AVAILABILITY	EDUCATION FACILITIES[2]	MEDICAL FACILITIES	RECREATION FACILITIES	PUBLIC UTILITIES[3]	REMARKS
Name: Chehalis Location: 46°39'N, 122°57'W; Lewis County, Washington	Census 1970: 5,727 Estimated 1975: 5,800 Projected 1980: 6,300	Houses: Total Number: 1,800 Number of Rentals: No data Average Monthly Rent: $180 Percent Rental Vacancies: 2% New House Starts: 23 Average Number of Sales per Year: No data Average Sale Price: $32,000 Apartments: Total Number: 538 (1970) Average Monthly Rent: $150 Average Percent Vacant: 1%	Elementary Schools: Number of Schools: 3 Enrollment Capacity: 1,600 1975 Enrollment: 2,085 1980 Projection: No data Jr. High Schools: Number of Schools: None Secondary Schools: Number of Schools: 1 Enrollment Capacity: 800 1975 Enrollment: 730 1980 Projection: No data	Doctors: Total Number: 10 Doctor/Population Ratio: 1/580 Dentists: Total Number: 7 Dentist/Population Ratio: 1/828 Hospitals: Total Number: 1 Total Beds: 99 Intensive Care Units: 1; total beds: 3 Coronary Care Units: 1; total beds: 3 Planned Expansion: None	Parks: 4 Athletic Fields: 13 Tennis Courts: 4 Golf Courses: 1	Electric Power: Source: Lewis County PUD No. 1 Type: Hydroelectric and thermoelectric Future Plants:A Nuclear plant Sewage Disposal: Number of Plants: 1 Type of Treatment: Secondary Flow Capacity, GPD: 5,000,000 Actual Flow, GPD: 3,000,000 Heating Fuels: Types Available: Natural gas, oil, coal, wood Expansion Plans: None Water Supply: Source: River Adequacy of Service: Excellent Expansion Plans: None	
Name: Des Moines Location: 47°24'N, 122°19'W; King County, Washington	Census 1970: 3,871 Estimated 1975: 6,250 Projected 1980: 8,000	Houses: Total Number: 1,100 Number of Rentals: No data Average Monthly Rent: $190 Percent Rental Vacancies: None New House Starts: 6 Average Number of Sales per Year: No data Average Sale Price: $35,000 Apartments: Total Number: 1,000 Average Monthly Rent: $185 Average Percent Vacant: 3%	Elementary Schools: Number of Schools: 2 Enrollment Capacity: 900 1975 Enrollment: 912 1980 Projection: 671 Jr. High Schools: Number of Schools: 1 Enrollment Capacity: 698 1975 Enrollment: 749 1980 Projection: 555 Secondary Schools: Number of Schools: 1 Enrollment Capacity: 1,090 1975 Enrollment: 1,570 1980 Projection: 1,980	Doctors: Total Number: 5 Doctor/Population Ratio: 1/1,250 Dentists: Total Number: 4 Dentist/Population Ratio: 1/1,562 Hospitals: None	Parks: 1 Athletic Fields: 7 Tennis Courts: 7	Electric Power: Source: Puget Sound Power and Light Company Type: Hydroelectric Future Plants: None Sewage Disposal: Number of Plants: 1 Type of Treatment: Primary Flow Capacity, GPD: 2,000,000 Actual Flow, GPD: 2,700,000 Heating Fuels: Types Available: Oil, gas Expansion Plans: No data Water Supply: Source: No Data Adequacy of Service: No data Expansion Plans: No data	
Name: Edmonds Location: 47°48'N, 122°22'W; Snohomish County, Washington	Census 1970: 23,998 Estimated 1975: 25,039 Projected 1980: 26,000	Houses: Total Number: 6,826 Number of Rentals: 136 Average Monthly Rent: $260 Percent Rental Vacancies: 1% New House Starts: 189 Average Number of Sales per Year: 340 Average Sale Price: $45,000 Apartments: Total Number: 1,979 Average Monthly Rent: $225 Average Percent Vacant: 1.9%	Elementary Schools: Number of Schools: 4 Enrollment Capacity: 1,718 1975 Enrollment: 2,028 1980 Projection: 2,000 Jr. High Schools: Number of Schools: None Secondary Schools: Number of Schools: 1 Enrollment Capacity: 1,314 1975 Enrollment: 1,308 1980 Projection: 1,280	Doctors: Total Number: 37 Doctor/Population Ratio: 1/677 Dentists: Total Number: 24 Dentist/Population Ratio: 1/1,043 Hospitals: Total Number: 1 Total Beds: 159 Intensive Care Units: 1; total beds: 6 Coronary Care Units: 1; total beds: 6 Planned Expansion: Add emergency section (no beds)	Parks: 14 Athletic Fields: 5 Tennis Courts: 8	Electric Power: Source: Snohomish County PUD No. 1 Type: Hydroelectric Future Plants: 1 nuclear plant Sewage Disposal: Number of Plants: 1 Type of Treatment: Primary Flow Capacity, GPD: 10,000,000 Actual Flow, GPD: 4,000,000 Heating Fuels: Types Available: Oil, natural gas Expansion Plans: No data Water Supply: Source: Seattle Water Department Adequacy of Service: No data Expansion Plans: Storage/service mains only	
Name: Enumclaw Location: 47°12'N, 121°59'W; King County, Washington	Census 1970: 4,703 Estimated 1975: 4,599 Projected 1980: 7,300	Houses: Total Number: 1,300 Number of Rentals: 100 Average Monthly Rent: $140 Percent Rental Vacancies: None New House Starts: 29 Average Number of Sales per Year: 300 Average Sale Price: $30,000 Apartments: Total Number: 220 Average Monthly Rent: $110 Average Percent Vacant: None	Elementary Schools: Number of Schools: 4 Enrollment Capacity: No data 1975 Enrollment: 1,561 1980 Projection: 1,717 Location: 3 in city of Enumclaw, 1 in King County. Jr. High Schools: Number of Schools: 1 Enrollment Capacity: No data 1975 Enrollment: 672 1980 Projection: 699 Secondary Schools: Number of Schools: 1 Enrollment Capacity: No data 1975 Enrollment: 1,237 1980 Projection: 1,250	Doctors: Total Number: 11 Doctor/Population Ratio: 1/418 Dentists: Total Number: 7 Dentist/Population Ratio: 1/657 Hospitals: Total Number: 1 Total Beds: 38 Intensive Care Units: 1; total beds: 1 Coronary Care Units: 1; total beds: 2 Planned Expansion: No data	Parks; 6 Athletic Fields: 11 Tennis Courts: 2 Golf Courses: 1	Electric Power: Source: White River Generating Station and Electron Generating Station Type: Hydroelectric Future Plants: Switching Station in King County Sewage Disposal: Number of Plants: 1 Type of Treatment: Secondary Flow Capacity, GPD: 2,000,000 Actual Flow, GPD: 1,500,000 Heating Fuels: Types Available: Natural gas, heating oil, L.P. gas Expansion Plans: No data Water Supply: Source: Springs Adequacy of Service: Adequate Expansion Plans: Wells in the future	
Name: Fircrest Location: 47°14'N, 122°31'W; Pierce County, Washington	Census 1970: 5,651 Estimated 1975: 5,651 Projected 1980: 6,000	Houses: Total Number: 1,625 Number of Rentals: 85 Average Monthly Rent: $225 Percent Rental Vacancies: 1% New House Starts: 19 Average Number of Sales per Year: 16 Average Sale Price: $55,000 Apartments: Total Number: 315 Average Monthly Rent: $200 Average Percent Vacant: 2.5%	Elementary Schools: Number of Schools: 2 Enrollment Capacity: No data 1975 Enrollment: No data Jr. High Schools: Number of Schools: None Secondary Schools: Number of Schools: None	Doctors: Total Number: 3 Doctor/Population Ratio: 1/1,883 Dentists: Total Number: 4 Dentist/Population Ratio: 1/1,412 Hospitals: Total Number: None	Parks: 6 Athletic Fields: 2 Tennis Courts: 6	Electric Power: Source: Bonneville Power Administration Type: No data Future Plants: None other than necessary substations Sewage Disposal: Number of Plants: None (Pumped into Tacoma trunk and treated by city of Tacoma) Heating Fuels: Types Available: Oil, gas Expansion Plans: None Water Supply: Source: Town-owned wells Adequacy of Service: Adequate Expansion Plans: Connection with Tacoma Water System for emergency service. No additional wells planned at this time	A residential community in the Tacoma urban area. Part of Tacoma School District No. 10. Students attend junior high and secondary schools in Tacoma.
Name: Issaquah Location: 47°32'N, 122°01'W; King County, Washington	Census 1970: 4,313 Estimated 1975: 4,706 Projected 1980: No data	Houses: Total Number: 1,026 (1970) Number of Rentals: No data Average Monthly Rent: No data Percent Rental Vacancies: No data New House Start: No data Average Number of Sales per Year: No data Average Sale Price: No data	No data	No data	No data	No data	

III. OFF-POST FEATURES, FORT LEWIS (continued)

TABLE III-B, URBAN AREAS[1] (continued)

NAME AND LOCATION	POPULATION	HOUSING AVAILABILITY	EDUCATION FACILITIES[2]	MEDICAL FACILITIES	RECREATION FACILITIES	PUBLIC UTILITIES[3]	REMARKS
		Apartments: Total Number: 460 (1970) Average Monthly Rent: No data Average Percent Vacant: No data					
Name: Kent Location: 47°23'N, 122°01'W; King County, Washington	Census 1970: 21,510 Estimated 1975: 16,928 Projected 1980: 20,000	Houses: Total Number: 3,415 Number of Rentals: 1,128 (1970) Average Monthly Rent: No data Percent Rental Vacancies: 3% New House Starts: 79 Average Number of Sales per Year: No data Average Sale Price: No data Apartments: Total Number: 2,794 Average Monthly Rent: No data Average Percent Vacant: 7%	Elementary Schools: Number of Schools: 15 Enrollment Capacity: No data 1975 Enrollment: 7,604 1980 Projection: No data Jr. High Schools: Number of Schools: 4 Enrollment Capacity: No data 1975 Enrollment: 3,756 1980 Projection: No data Secondary Schools: Number of Schools: 2 Enrollment Capacity: No data 1975 Enrollment: 3,273 1980 Projection: No data	Doctors: Total Number: Over 100 Doctor/Population Ratio: 1/169 Dentists: Total Number: 35 Dentist/Population Ratio: 1/484 Hospitals: Total Number: 1 Total Beds: 254 Intensive Care Units: No data Coronary Care Units: No data Planned Expansion: No data	Parks: 8 Athletic Fields: 40 Tennis Courts: 18 Golf Courses: 2	Electric Power: Source: Puget Sound Power and Light Company Type: Hydroelectric Future Plants: No data Sewage Disposal: Metro[4] Heating Fuels: Types Available: Natural gas Expansion Plans: No data Water Supply: Source: Springs Adequacy of Service: Excellent Expansion Plans: No data	
Name: Kirkland Location: 47°40'N, 122°12'W; King County, Washington	Census 1970: 15,249 Estimated 1975: 15,000 Projected 1980: 16,000	Houses: Total Number: 4,057 Number of Rentals: 203 Average Monthly Rent: No data Percent Rental Vacancies: Less than 3% New House Starts: 135 Average Number of Sales per Year: No data Average Sale Price: $42,000 Apartments: Total Number: 2,160 Average Monthly Rent: No data Average Percent Vacant: Less than 3%	Elementary Schools: Number of Schools: 4 Enrollment Capacity: No data 1975 Enrollment: No data Location: King County Jr. High Schools: Number of Schools: 2 Enrollment Capacity: No data 1975 Enrollment: No data Location: King County Secondary Schools: Number of Schools: 2 Enrollment Capacity: No data 1975 Enrollment: No data Colleges: Number of Schools: 1 (Northwest College, Private) 1975 Enrollment: 627	Doctors: Total Number: 85 Doctor/Population Ratio: 1/176 Dentists: Total Number: 30 Dentist/Population Ratio: 1/500 Hospitals: Total Number: 1 Location: City of Kirkland Total Beds: 73 Intensive Care Units: 1; total beds: 4 Coronary Care Units: 1; total beds: 6 Planned Expansion: No data	Parks: 12 Athletic Fields: 4 Tennis Courts: 6	Electric Power: Source: Puget Sound Power and Light Company Type: Hydroelectric Future Plants: No data Sewage Disposal: Metro[4] Heating Fuels: No data Water Supply: Source: Seattle Water Department Adequacy of Service: Good Expansion Plans: No data	School district extends beyond city limits. School facilities counted are considered to include many students from Kirkland.
Name: Lacey Location: 47°02'N, 122°49'W; Thurston County, Washington	Census 1970: 9,696 Estimated 1975: 10,733 Projected 1980: 13,700	Houses: Total Number: 10,489 Number of Rentals: 120 Average Monthly Rent: $80 Percent Rental Vacancies: 1.4% New House Starts: 179 Average Number of Sales per Year: 160 Average Sale Price: $24,000 Apartments: Total Number: 220 Average Monthly Rent: $150 Average Percent Vacant: 7.9%	Elementary Schools: Number of Schools: 6 Enrollment Capacity: 3,000 1975 Enrollment: 3,085 1980 Projection: 4,000 Location: 2 in city of Lacey, 4 in Thurston County Jr. High Schools: Number of Schools: 2 Enrollment Capacity: 1,200 1975 Enrollment: 1,397 1980 Projection: 1,700 Location: 1 in city of Lacey, 1 in Thurston County Secondary Schools: Number of Schools: 2 Enrollment Capacity: 1,500 1975 Enrollment: 2,087 1980 Projection: 2,800 Colleges: Number of Schools: 1 (St. Martins College, private) 1975 Enrollment: 843	See Olympia for medical facilities in the 3-city area	Parks: 3 Athletic Fields: 3 Tennis Courts: 2	Electric Power: Source: Puget Sound Power and Light Company Type: Hydroelectric Future Plants: None Sewage Disposal: Number of Plants: None (Makes use of plant in Olympia) Heating Fuels: Types Available: Oil, natural gas Expansion Plans: None Water Supply: Source: City-owned wells Adequacy of Service: Adequate Expansion Plans: None	Many services, both public and private, are shared by the three cities of Lacey, Tumwater, and Olympia. School districts extend beyond the city limits.
Name: Lake Forest Park Location: 47°45'N, 122°15'W; King County, Washington	Census 1970: 2,530 Estimated 1975: 2,530 Projected 1980: No data	Houses: Total Number: 835 Number of Rentals: 20 Average Monthly Rent: No data Percent Rental Vacancies: No data New House Starts: 6 Average Number of Sales per Year: No data Average Sale Price: No data Apartments: None	Elementary Schools: Number of Schools: 2 Enrollment Capacity: No data 1975 Enrollment: No data 1980 Projection: No data Location: 1 in city of Lake Forest Park and 1 in King County Jr. High Schools: Number of Schools: 1 Enrollment Capacity: No data 1975 Enrollment: No data Location: King County	No data	Parks: None Athletic Fields: 1 Tennis Courts: 2	No data	
Name: Medina Location: 47°37'N, 122°14'W; King County, Washington	Census 1970: 3,455 Estimated 1975: 3,455 Projected 1980: No data	Houses: Total Number: 1,345 Number of Rentals: No data Average Monthly Rent: No data Percent Rental Vacancies: None New House Starts: No data Average Number of Sales per Year: No data Average Sale Price: No data Apartments: None	Elementary Schools: Number of Schools: 2 Enrollment Capacity: No data 1975 Enrollment: No data Jr. High Schools: No data Secondary Schools: No data	No data	Parks: 3 Tennis Courts: 2 Golf Courses: 1	Electric Power: Source: Puget Sound Power and Light Company Type: Hydroelectric Future Plants: No data Sewage Disposal: No data Heating Fuels: Types Available: Oil, gas Expansion Plans: No data Water Supply: Source: City of Bellevue Adequacy of Service: Good Expansion Plans: No data	
Name: Mercer Island City Location: 47°34'N, 122°13'W; King County, Washington	Census 1970: 19,047 Estimated 1975: 20,500 Projected 1980: 23,000	Houses: Total Number: 5,741 Number of Rentals: 300 Average Monthly Rent: $360 Percent Rental Vacancies: 3.5% New House Starts: 152 Average Number of Sales per Year: 521 Average Sale Price: $59,550 Apartments: Total Number: 3,583 Average Rent: $250 to $275 Average Percent Vacant: 4.7%	Elementary Schools: Number of Schools: 5 Enrollment Capacity: No data 1975 Enrollment: 2,362 1980 Projection: 1,853 Jr. High Schools: Number of Schools: 2 Enrollment Capacity: No data 1975 Enrollment: 1,379 1980 Projection: 1,191	Doctors: Total Number: 25 Doctor/Population Ratio: 1/820 Dentists: Total Number: 14 Dentist/Population Ratio: 1/1,464 Hospitals: No data	Parks: 10 Athletic Fields: 3 Tennis Courts: 44	Electric Power: Source: Puget Sound Power and Light Company Type: Hydroelectric Future Plans: No data Sewage Disposal: Metro[4] Heating Fuels: Types Available: Oil, gas Expansion Plans: No data Water Supply: No data	

TABLE III-B, URBAN AREAS[1] (continued)

NAME AND LOCATION	POPULATION	HOUSING AVAILABILITY	EDUCATION FACILITIES[2]	MEDICAL FACILITIES	RECREATION FACILITIES	PUBLIC UTILITIES[3]	REMARKS
			Secondary Schools Number of Schools: 1 Enrollment Capacity: No data 1975 Enrollment: 1,607 1980 Projection: 1,449				
Name: Milton Location 47°14'N, 122°19'W; Pierce County, Washington	Census 1970: 2,607 Estimated 1975: 2,624 Projected 1980: No data	Houses: Total Number: 771 (1970) Number of Rentals: No data Average Monthly Rent: No data Percent Rental Vacancies: No data New House Starts: No data Average Number of Sales per Year: No data Average Sale Price: No data Apartments: Total Number: 55 (1970) Average Monthly Rent: No data Average Percent Vacant: No data	No data	No data	No data	No data	
Name: Montesano Location: 46°35'N, 123°35'W; Grays Harbor County, Washington	Census 1970: 2,847 Estimated 1975: 2,775 Projected 1980: 3,700	Houses: Total Number: 882 (1970) Number of Rentals: No data Average Monthly Rent: No data Percent Rental Vacancies: No data New House Starts: No data Average Number of Sales per Year: No data Average Sale Price: No data Apartments: Total Number: 137 (1970) Average Monthly Rent: No data Average Percent Vacant: No data	No data	No data	No data	Electric Power: Source: Gray's Harbor County PUD No. 1 Type: No data Future Plants: No data Sewage Disposal: Number of Plants: 1 Type of Treatment: Primary Flow Capacity, GPD: 1,000,000 Average Flow, GPD: 800,000 Heating Fuels: No data Water Supply: Source: Wells Adequacy of Service: No data Expansion Plans: No data	
Name: Mountlake Terrace Location: 47°47'N, 122°18'W; Snohomish County, Washington	Census 1970: 16,600 Estimated 1975: 16,400 Projected 1980: 17,000	Houses: Total Number: 4,325 Number of Rentals: 865 Average Monthly Rent: $250 Percent Rental Vacancies: Less than 1% New House Starts: 37 Average Number of Sales per Year: No data Average Sale Price: No data Apartments: Total Number: 800 Average Monthly Rent: $175 Average Percent Vacant: 3%	Elementary Schools: Number of Schools: 2 Enrollment Capacity: No data 1975 Enrollment: No data 1980 Projection: No data Jr. High Schools: Number of Schools: 1 Enrollment Capacity: No data 1975 Enrollment: No data Secondary Schools: Number of Schools: 1 Enrollment Capacity: No data 1975 Enrollment: No data	Doctors: Total Number: 5 Doctor/Population Ratio: 1/3,280 Dentists: Total Number: 2 Dentist/Population Ratio: 1/8,200 Hospitals: Total Number: None	Parks: 12 Athletic Fields: 4 Tennis Courts: 6 Golf Courses: 1	Electric Power: Source: Public Utility District Type: Hydroelectric Future Plants: No data Sewage Disposal: Number of Plants: 1 Type of Treatment: Primary Flow Capacity, GPD: 4,000,000 Actual Flow, GPD: 850,000 Heating Fuels: Types Available: Natural gas, oil Expansion Plans: New residential developments Water Supply: Sultan River basin Adequacy of Service: Good Expansion Plans: New residential developments	
Name: Olympia Location: 47°02'N, 122°53'W; Thurston County, Washington	Census 1970: 23,111 Estimated 1975: 25,800 Projected 1980: 27,600	Houses Total Number: 7,403 Number of Rentals: 2,844 Average Monthly Rent: No data Percent Rental Vacancies: No data New House Starts: 54 Average Number of Sales per Year: No data Average Sale Price: $34,000 Apartments: Total Number: 1,985 (1970) Average Monthly Rent: $180 Average Percent Vacant: No data	Elementary Schools: Number of Schools: 10 Enrollment Capacity: No data 1976 Enrollment: No data Jr. High Schools: Number of Schools: 3 Enrollment Capacity: 1,750 1976 Enrollment: 1,708 1980 Projection: No data Secondary Schools: Number of Schools: 2 Enrollment Capacity: 2,450 1976 Enrollment: 2,379 1980 Projection: No data Colleges: Number of Schools: 2 (The Evergreen State College, and OVTI Centralia Community College) 1975 Enrollment: 5,119	Doctors: Total Number: 144 Doctor/Population Ratio: 1/295 Dentists: Total Number: 59 Dentist/Population Ratio: 1/719 Hospitals: Total Number: 1 Total Beds: 170 Intensive Care Units: 1; total beds: 5 Coronary Care Units: 1; total beds: 7 Planned Expansion: No data	Parks: 12 Athletic Fields: 20 Tennis Courts: 14	Electric Power: Source: Puget Sound Power and Light Company Type: Hydroelectric Future Plants: No data Sewage Disposal: Number of Plants: 1 Type of Treatment: Primary Flow Capacity, GPD: 10,000,000 Average Flow, GPD: 4,500,000 Heating Fuels: Types Available: Gas, oil Expansion Plans: No data Water Supply: Source: Springs Adequacy of Service; Adequate Expansion Plans: Yes, no details	Many services, both public and private, including schools and medical facilities, are shared by the three cities of Olympia, Lacey, and Tumwater. Medical facilities in Olympia are also utilized by Lacey and Tumwater. Number of doctors and dentists shown here includes those in the 3-city area. School districts are not limited by municipal boundaries.
Name: Parkland (unincorporated) Location: 47°09'N, 122°26'W; Pierce County, Washington	Census 1970: 21,012 Estimated 1975: 22,300 Projected 1980: 23,560	Houses: Total Number: 5,056 Number of Rentals: 525 Average Monthly Rent: $170 Percent Rental Vacancies: 5.7% New House Starts: 195 (1974) Average Number of Sales per Year: No data Average Sale Price: No data Apartments: Total Number: 1,608 Average Monthly Rent: $150 Average Percent Vacant: 5.7%	Elementary Schools: Number of Schools: 9 Enrollment Capacity: 5,000 1975 Enrollment: 3,596 1980 Projection: 3,100 Jr. High Schools: Number of Schools: 2 Enrollment Capacity: 2,100 1975 Enrollment: 1,960 1980 Projection: 1,800 Secondary Schools: Number of Schools: 2 Enrollment Capacity: 2,600 1975 Enrollment: 1.962 1980 Projection: 1,760 Colleges: Number of Schools: 1 (Pacific Lutheran University, private) 1975 Enrollment: 3,428	Doctors: Total Number: 5 Doctor/Population Ratio: 1/4,460 Dentists. Total Number: 5 Dentist/Population Ratio: 1/4,460 Hospitals: Total Number: None	Parks: 3 Athletic Fields: 15 Tennis Courts: 10 Golf Courses: 2	Electric Power: Source: Bonneville Power Administration Type: Hydroelectric Future Plants: No data Sewage Disposal: Number of Plants: None Heating Fuels: Types Available: Oil, natural gas, coal, wood Expansion Plans: No data Water Supply: Source: City of Tacoma, ground water Adequacy of Service; Limited in fire flow capacities Expansion Plans. No data	
Name: Port Orchard Location: 47°32'N, 122°38'W; Kitsap County, Washington	Census 1970: 3,904 Estimated 1975: 4,065 Projected 1980: 6,500	Houses: Total Number: 1,672 Number of Rentals: 45 Average Monthly Rent: $190 Percent Rental Vacancies: 6% New House Starts: 5 Average Number of Sales per Year: No data Average Sale Price: $21,050	Elementary Schools: Number of Schools: 1 Enrollment Capacity: 526 1975 Enrollment: 606 1980 Projection: 536 Jr. High Schools: Number of Schools: 1	Doctors: Total Number: 10 Doctor/Population Ratio: 1/425 Dentists: Total Number: 7 Dentist/Population Ratio: 1/607	Parks: 5 Athletic Fields: 2 Tennis Courts: 2	Electric Power: Source: Puget Sound Power and Light Company Type: Hydroelectric Future Plants: No data Sewage Disposal: Number of Plants: 1 Type of Treatment: Primary	TRIDENT program is likely to have impact on the population, housing, and school educational facilities at Port Orchard.

III. OFF-POST FEATURES, FORT LEWIS (continued)

TABLE III-B, URBAN AREAS[1] (continued)

NAME AND LOCATION	POPULATION	HOUSING AVAILABILITY	EDUCATION FACILITIES[2]	MEDICAL FACILITIES	RECREATION FACILITIES	PUBLIC UTILITIES[3]	REMARKS
		Apartments: Total Number: 427 Average Monthly Rent: $200 Average Percent Vacant: No data	Enrollment Capacity: 610 1975 Enrollment: 888 1980 Projection: 1,000 Secondary Schools: Number of Schools: 1 Enrollment Capacity: 1,500 1975 Enrollment: 1,500 1980 Projection: 2,100 Location: Kitsap County	Hospitals: Total Number: None		Flow Capacity, GPD: 1,000,000 Actual Flow, GPD: 600,000 Heating Fuels: Types Available: Diesel, natural gas Expansion Plans: No data Water Supply: Source: Wells and City of Bremerton Adequacy of Service: Good Expansion Plans: Under construction now are 2 million-gallon reservoir transmission mains connecting to City of Bremerton at Anderson Hill Pump Station.	
Name: Puyallup Location: 47°11'N, 122°17'W; Pierce County, Washington	Census 1970: 14,742 Estimated 1975: 15,000 Projected 1980: 18,777	Houses: Total Number: 4,531 Number of Rentals: 588 Average Monthly Rent: $280 Percent Rental Vacancies: 1.2% New House Starts: 216 Average Number of Sales per Year: 342 Average Sale Price: $39,500 Apartments: Total Number: 1,216 Average Monthly Rent: $190 Average Percent Vacant: No data	Elementary Schools: Number of Schools: 11 Enrollment Capacity: 5,800 1975 Enrollment: 5,646 1980 Projection: 6,000 Jr. High Schools: Number of Schools: 3 Enrollment Capacity: 2,750 1975 Enrollment: 2,885 1980 Projection: 3,000 Secondary Schools: Number of Schools: 2 Enrollment Capacity: 2,650 1975 Enrollment: 2,570 1980 Projection: 2,800	Doctors: Total Number: 42 Doctor/Population Ratio: 1/360 Dentists: Total Number: 30 Dentist/Population Ratio: 1/503 Hospitals: Total Number: 1 Total Beds: 200 Intensive Care Units: 1; total beds: 10 Coronary Care Units: 1; total beds: 5	Parks: 6 Athletic Fields: 14 Tennis Courts: 3 Golf Courses: 1	Electric Power: Source: Puget Sound Power and Light Company Type: Hydroelectric Future Plants: No data Sewage Disposal: Number of Plants: 1 Type of Treatment: Primary (secondary planned) Flow Capacity, GPD: 6,000,000 Actual Flow, GPD: 4,000,000 Heating Fuels: Types Available: Natural gas, oil Expansion Plans: None Water Supply: Source: Springs and wells Adequacy of Service: More than adequate Expansion Plans: Addition of 2 million gallons of storage	
Name: Redmond Location: 47°40'N, 122°07'W; King County, Washington	Census 1970: 11,031 Estimated 1975: 14,200 Census 1976: 16,445 Projected 1985: 22,000	Houses: Total Number: 4,059 Number of Rentals: 398 (1970) Average Monthly Rent: No data Percent Rental Vacancies: 6% New House Starts: 411 Average Number of Sales per Year: 300 Average Sale Price: $40,000 Apartments: Total Number: 1,554 Average Monthly Rent: $230 Average Percent Vacant: 7%	Elementary Schools: Number of Schools: 3 Enrollment Capacity: 1805 1976 Enrollment: 2,586 1980 Projection: No data Jr. High Schools: Number of Schools: 2 Enrollment Capacity: 1,461 1976 Enrollment: 1,784 1980 Projection: No data Secondary Schools: Number of Schools: 1 Enrollment Capacity: 975 1976 Enrollment: 943 1980 Projection: No data	Doctors: Total Number: 9 Doctor/Population Ratio: 1/1,578 Dentists: Total Number: 16 Dentist/Population Ratio: 1/887	Parks: 13 Athletic Fields: 20 Tennis Courts: 22 Golf Courses: 4	Electric Power: Source: Puget Sound Power and Light Company Type: Hydroelectric Future Plants: No data Sewage Disposal: Metro[4] Heating Fuels: Types Available: Natural gas Expansion Plans: No data Water Supply: Source: City wells and Seattle Water system Adequacy of Service: Good Expansion Plans: As needed	
Name: Renton Location: 47°29'N, 122°12'W; King County, Washington	Census 1970: 25,878 Estimated 1975: 27,300 Projected 1980: 27,900	Houses: Total Number: 6,627 Number of Rentals: 1,253 (1970) Average Monthly Rent: No data Percent Rental Vacancies: 1.2% New House Starts: No data Average Number of Sales per Year: No data Average Sale Price: No data Apartments: Total Number: 3,546 Average Monthly Rent: No data Average Percent Vacant: 4%	Elementary Schools: Number of Schools: 16 Enrollment Capacity: 8,000 1975 Enrollment: 7,775 1980 Projection: 6,052 Jr. High Schools: Number of Schools: 3 Enrollment Capacity: 2,800 1975 Enrollment: 2,415 1980 Projection: 1,824 Secondary Schools: Number of Schools: 3 Enrollment Capacity: 5,000 1975 Enrollment: 4,500 1980 Projection: 3,854	Doctors: Total Number: 132 Doctor/Population Ratio: 1/207 Dentists: Total Number: 7 Dentist/Population Ratio: 1/3,900 Hospitals: Total Number: 1 Location: King County Total Beds: 254 Intensive Care Units: 1; total beds: 7 Coronary Care Units: 1; total beds: 6 Planned Expansion: Yes, no details	Parks: 20 Atheltic Fields: 11 Tennis Courts: 12 Golf Courses: 1	Electric Power: Source: Puget Sound Power and Light Company Type: Hydroelectric Future Plants: No data Sewage Disposal: Metro[4] Heating Fuels: Types Available: Natural gas, oil Expansion Plans: No data Water Supply: Source: Wells, springs, and Seattle facilities Adequacy of Service: No data Expansion Plans: No data	Data on education facilities is for Renton School District No. 403, which is an area greater than the city limits.
Name: Seattle Location: 47°35'N, 122°19'W; King County, Washington	Census 1970: 530,831 Estimated 1975: 490,000 Projected 1980: 495,000	Houses: Total Number: 133,800 Number of Rentals: 23,213 (1970) Average Monthly Rent: No data Percent Rental Vacancies: 1.8% New House Starts: 361 Average Number of Sales per Year: No data Average Sale Price: $30,000 Apartments: Total Number: 92,000 Average Monthly Rent: No data Average Percent Vacant: 4%	Elementary Schools: Number of Schools: 85 Enrollment Capacity: No Data 1975 Enrollment: 32,300 1980 Projection: No data Jr. High Schools: Number of Schools: 18 Enrollment Capacity: No data 1975 Enrollment: 15,300 1980 Projection: No data Secondary Schools: Number of Schools: 12 Enrollment Capacity: No data 1975 Enrollment: 15,500 1980 Projection: No data Colleges: Number of Schools: 7 (University of Washington, Seattle Central Community College, Seattle North Community College, Shoreline Community College; and private schools, Seattle University and Seattle Pacific College) 1975 Enrollment: Approximately 65,945	Doctors: Total Number: 2,443 Doctor/Population Ratio: 1/200 Dentists: Total Number: 666 Dentist/Population Ratio: 1/736 Hospitals: Total Number: 18 Total Beds: 4,173 Intensive Care Units: 18; total beds: 171 (6 units included here provide both intensive and coronary care) Coronary Care Units: 11; total beds: 81 Planned Expansion: 2 hospitals plan replacement projects for improved facilities with a net increase of 4 intensive care beds, 11 special care beds, and 14 general medical-surgical beds. Planned merger will result in a reduction of 150 beds.	Parks: 143 Athletic Fields: 183 (13 track, 114 baseball/softball, 56 football/soccer) Tennis Courts: 128 Golf Courses: 5	Electric Power: Source: Seattle City Light Company facilities plus purchases from Bonneville Power Administration Type: Hydroelectric and thermoelectric Future Plants: High Ross Dam and Copper Creek on Skagit River Sewage Disposal: Metro[4] Heating Fuels: Types Available: Oil, natural gas Expansion Plans: Limited Water Supply: Source: Seattle Water Department from Cedar and Tolt Rivers Adequacy of Service: Adequate, pressure and coverage sufficient for AA fire rating Expansion Plans: Pending	Plus 42 parochial schools, including 6 high schools. The Metro sewage system provides treatment and disposal of sewage for the Seattle Metropolitan area.
Name: Shelton Location: 47°12'N, 123°06'W; Mason County, Washington	Census 1970: 6,515 Estimated 1975: 6,478 Projected 1980: 7,000	Houses: Total Number: 2,091 Number of Rentals: No data Average Monthly Rent: $150 Percent Rental Vacancies: 2% New House Starts: 10 Average Number of Sales per Year: 200 Average Sale Price: $25,000 Apartments: Total Number: 129 Average Monthly Rent: $175	Elementary Schools: Number of Schools: 3 Enrollment Capacity: No data 1976 Enrollment: 1,509 1980 Projection: No data Jr. High Schools: Number of Schools: 1 Enrollment Capacity: No data 1976 Enrollment: 607 1980 Projection: No data Secondary Schools:	Doctors: Total Number: 12 Doctor/Population Ratio: 1/540 Dentists: Total Number: 5 Dentist/Population Ratio: 1/1,296 Hospitals: Total Number: 1 Total Beds: 65 Intensive Care Units: 1; total beds: 8	Parks: 5 Athletic Fields: 2 Tennis Courts: 4	Electric Power: Source: Public Utility District Type: Hydroelectric Future Plants: No data Sewage Disposal: Number of Plants: 1 Type of Treatment: Primary Flow Capacity, GPD: 1,800,000 Actual Flow, GPD: 2,000,000 Heating Fuels:	A total increase in school enrollment of 750 is expected by 1980 due to the expanding TRIDENT program which is expected to have some impact on Shelton.

TABLE III-B, URBAN AREAS[1] (continued)

NAME AND LOCATION	POPULATION	HOUSING AVAILABILITY	EDUCATION FACILITIES[2]	MEDICAL FACILITIES	RECREATION FACILITIES	PUBLIC UTILITIES[3]	REMARKS
		Average Percent Vacant: 5%	Number of Schools: 1 Enrollment Capacity: No data 1976 Enrollment: 1,156 1980 Projection: No data	Coronary Care Units: Same facilities as for intensive care Planned Expansion: No data		Types Available: Oil, natural gas Expansion Plans: No data Water Supply: Source: Wells and springs Adequacy of Service: Good Expansion Plans: Enough yearly to cover growth	
Name: Spanaway (unincorporated) Location: 47°06'N, 122°26'W; Pierce County, Washington	Census 1970: 7,134 Estimated 1975: 8,626 Projected 1980: 9,057	Houses: Total Number: 2,116 Number of Rentals: 225 Average Monthly Rent: $170 Percent Rental Vacancies: 5.9% New House Starts: 574 (in 1974) Average Number of Sales per Year: No data Average Sale Price: No data Apartments: Total Number: 315 Average Monthly Rent: $145 Average Percent Vacant: 5.9%	Elementary Schools: Number of Schools: 4 Enrollment Capacity: 1,588 1975 Enrollment: 2,415 1980 Projection: 2,717 Jr. High Schools: Number of Schools: 2 Enrollment Capacity: 1,005 1975 Enrollment: 1,712 1980 Projection: 1,984 Secondary Schools: Number of Schools: 1 Enrollment Capacity: 1,161 1975 Enrollment: 1,434 1980 Projection: 1,662	Doctors: Total Number: No data Dentists: Total Number: No data Hospitals: Total Number: None	Parks: 1 Athletic Fields: 6 Tennis Courts: 3 Golf Courses: 1	Electric Power: Source: Bonneville Power Administration Type: Hydroelectric Future Plants: No Data Sewage Disposal: Number of Plants: None Heating Fuels: Types Available: Oil, natural gas, coal, wood Expansion Plans: No data Water Supply: Source: Wells Adequacy of Service: Water pressure too low Expansion Plans: No data	
Name: Steilacoom Location: 47°10'N, 122°36'W; Pierce County, Washington	Census 1970: 2,850 Estimated 1975: 4,460 Projected 1980: 5,210	Houses: Total Number: 1,173 Number of Rentals: 50 Average Monthly Rent: No data Percent Rental Vacancies: 1% New House Starts: 53 Average Number of Sales per Year: No data Average Sale Price: $38,000 Apartments: Total Number: 492 Average Monthly Rent: No data Average Percent Vacant: 1%	Elementary Schools: Number of Schools: 3 Enrollment Capacity: No data 1975 Enrollment: No data 1980 Projection: No data Jr. High Schools: None Secondary Schools: None	None	Parks: 3 Athletic Fields: 1 Tennis Courts: 5	Electric Power: Source: Bonneville Power Administration Type: Hydroelectric Future Plants: Hydroelectric and thermoelectric Sewage Disposal: Number of Plants: 1 Type of Treatment: Primary Flow Capacity, GPD: 600,000 Actual Flow, GPD: 1,500,000 Heating Fuels: Types Available: None Water Supply: Source: Wells Adequacy of Service: Good Expansion Plans: No data	
Name: Sumner Location: 47°12'N, 122°14'W; Pierce County, Washington	Census 1970: 4,325 Estimated 1975: 4,325 Projected 1980: 4,500	Houses: Total Number: 1,201 Number of Rentals: No data Average Monthly Rent: $225 Percent Rental Vacancies: 2.4% New House Starts: 11 Average Number of Sales per Year: No data Average Sale Price: No data Apartments: Total Number: 515 Average Monthly Rent: $160 Average Percent Vacant: 4.6%	Elementary Schools: Number of Schools: 4 Enrollment Capacity: 1,900 1975 Enrollment: 1,980 1980 Projection: 2,000 Location: 2 inside City of Sumner, 2 in Pierce County Jr. High Schools: Number of Schools: 1 (1 more planned) Enrollment Capacity: 900 1975 Enrollment: 1,012 1980 Projection: 1,200 Secondary Schools: Number of Schools: 1 Enrollment Capacity: 800 1975 Enrollment: 980 1980 Projection: 1,200	Doctors: Total Number: 5 Doctor/Population Ratio: 1/865 Dentists: Total Number: 6 Dentist/Population Ratio: 1/721 Hospitals: Total Number: None	Parks: 3 Athletic Fields: 6 Tennis Courts: 2	Electric Power: Source: Puget Sound Power and Light Company Type: Hydroelectric Future Plants: No data Sewage Disposal: Number of Plants: 1 Type of Treatment: Secondary-activated sludge Flow Capacity, GPD: 2,000,000 Actual Flow, GPD: 800,000 Heating Fuels: Types Available: Oil, natural gas Expansion Plans: No data Water Supply: Source: Springs and wells Adequacy of Service: Good Expansion Plans: As needed	
Name: Tacoma Location: 47°14'N, 122°26'W; Pierce County, Washington	Census 1970: 154,581 Estimated 1975: 156,500 Projected 1980: 159,600	Houses: Total Number: 62,426 Number of Rentals: 7,116 (1970) Average Monthly Rent: No data Percent Rental Vacancies: 2.7% New House Starts: 373 Average Number of Sales per Year: No data Average Sale Price: No data Apartments: Total Number: 12,865 (1970) Average Monthly Rent: No data Average Percent Vacant: 5.7%	Elementary Schools: Number of Schools: 41 Enrollment Capacity: No data 1975 Enrollment: 16,928 1980 Projection: No data Jr. High Schools: Number of Schools: 10 Enrollment Capacity: No data 1975 Enrollment: 7,826 1980 Projection: No data Secondary Schools: Number of Schools: 5 Enrollment Capacity: No data 1975 Enrollment: 7,826 1980 Projection: No data Colleges: Number of Schools: 3 (Tacoma Community College, Fort Steilacoom Community College; and private school, University of Puget Sound) 1975 Enrollment: 18,691	Doctors: Total Number: 254 Doctor/Population Ratio: 1/616 Dentists: Total Number: 168 Dentists/Population Ratio: 1/931 Hospitals: Total Number: 6 Total Beds: 1,100	Parks: 31 Athletic Fields: 27 Tennis Courts: 10 Golf Courses: 3	Electric Power: Source: Tacoma City Light Company Type: Hydroelectric and thermoelectric Future Plants: No data Sewage Disposal: Number of Plants: No data Type of Treatment: Primary Flow Capacity, GPD: 39,000,000 Actual Flow, GPD: 30,000,000 Heating Fuels: Types Available: Oil, natural gas Expansion Plans: No data Water Supply: Source: Green River and wells Adequacy of Service: Unknown Expansion Plans: No data	Plus 15 parochial schools, including 2 high schools
Name: Tukwila Location: 47°28'N, 122°15'W; King County, Washington	Census 1970: 3,496 Estimated 1975: 3,317 Projected 1980: 5,000	Houses: Total Number: 550 Number of Rentals: No data Average Monthly Rent: No data Percent Rental Vacancies: 1.5% New House Starts: 4 Average Number of Sales per Year: No data Average Sale Price: No data Apartments: Total Number: 1,131 Average Monthly Rent: $170 Average Percent Vacant: 4%	Elementary Schools Number of Schools: 1 Enrollment Capacity: 420 1975 Enrollment: 213 1980 Projection: 200 Jr. High Schools: Number of Schools: 1 Enrollment Capacity: 700 1975 Enrollment: 531 1980 Projection: 525 Location: King County Secondary Schools: Number of Schools: 1 Enrollment Capacity: 750 1975 Enrollment: 531 1980 Projection: 525 Location: King County	Doctors: Total Number: 19 Doctor/Population Ratio: 1/175 Dentists: Total Number: 15 Dentist/Population Ratio: 1/221 Hospitals: No data	Parks: 1 Athletic Fields: 1 Tennis Courts: 3 Golf Courses: 1	Electric Power: Source: Puget Sound Power and Light Company Type: Hydroelectric Future Plants: No data Sewage Disposal: Metro[4] Heating Fuels: Types Available: Natural gas Expansion Plans: No data Water Supply: Source: Seattle Water Department, Cedar River Adequacy of Service: Good Expansion Plans: Minimal	

TABLE III-B, URBAN AREAS[1] (continued)

NAME AND LOCATION	POPULATION	HOUSING AVAILABILITY	EDUCATION FACILITIES[2]	MEDICAL FACILITIES	RECREATION FACILITIES	PUBLIC UTILITIES[3]	REMARKS
Name: Tumwater Location: 47°00'N, 122°54'W; Thurston County, Washington	Census 1970: 5,373 Estimated 1975: 5,373; 1976: 5,894 Projected 1980: 6,100	Houses: Total Number: 2,574 Number of Rentals: 100 Average Monthly Rent: $190 Percent Rental Vacancies: 5% New House Starts: 38 Average Number of Sales per Year: 38 Average Sale Price: $34,000 Apartments: Total Number: 661 Average Monthly Rent: $170 Average Percent Vacant: No data	Elementary Schools: Number of Schools: 4 Enrollment Capacity: No data 1976 Enrollment: 1,570 1980 Projection: No data Jr. High Schools: Number of Schools: 1 Enrollment Capacity: No data 1976 Enrollment: 801 1980 Projection: No data Secondary Schools: Number of Schools: 1 Enrollment Capacity: No data 1976 Enrollment: 958 1980 Projection: No data	See Olympia for medical facilities in the three-city area.	Parks: 3 Athletic Fields: 4 Tennis Courts: 8 Golf Courses: 1	Electric Power: Source: Puget Sound Power and Light Company Type: Hydroelectric Future Plants: No data Sewage Disposal: None (makes use of plant in Olympia) Heating Fuels: Types Available: Gas, oil Expansion Plans: No data Water Supply: Source: Wells Adequacy of Service: Fairly adequate Expansion Plans: Yes, details not known	Many services, both public and private, are shared by the three cities of Tumwater, Olympia, and Lacey. School districts are not limited by city boundaries

[1]Data in the table is generally for 1975 unless noted otherwise. Most of the data were obtained from questionnaires filled out at the offices of the mayors of the city.
[2]School districts are not limited by municipal boundaries. A district may include all or part of a city, plus part of the county and/or part of an adjacent city. School enrollment may appear to be a high percentage of a city population because many students may live outside the city.
[3]GPD under sewage disposal is the flow or capacity in gallons per day.
[4]Sewage disposal for the community is provided by the Municipality of Metropolitan Seattle (Metro), an agency which provides sewage treatment for the Seattle metropolitan area. Four primary plants discharge into Puget Sound and one secondary plant discharges into the Duwamish River. Flow capacity 400,000,000 GPD; average flow 160,000,000 GPD.

TABLE III-C, PORTS

NAME AND LOCATION	TYPE AND GENERAL CONDITION[1]	FACTORS LIMITING LARGEST VESSEL	HYDROLOGIC CONDITIONS AND UNUSUAL GEOPHYSICAL CONDITIONS[2]	PIERS AND WHARVES	MECHANICAL HANDLING FACILITIES	STORAGE FACILITIES[3]	CLEARANCE FACILITIES	REMARKS
Name: Port of Anacortes Location: 48°31'N, 122°37'W	Type: Artificial Condition: Good Cargo Handling: 3,603,239.6 m.t. (3,971,825 s.t.) handled in 1974	Approaches: Minimum depth 10.7 m (35 ft); minimum width 152.4 m (500 ft) Anchorages: Minimum depth 15.5 m (51 ft) Alongside Berths: Minimum depth 1.8 m (6 ft); maximum length 337 m (1,107 ft)	Tidal Ranges: Mean range of tide is 1.5 m (4.8 ft); range between MLLW and MHHW is 2.5 m (8.2 ft) Unusual Geophysical Condition: Local magnetic disturbance differences from normal variation as much as 14° have been observed 3.2 km (2 mi) northeast of the port and about 2° variation 3.2 km (2 mi) east of the port.	Number: 17 Uses: For handling of petroleum products, general cargo, fish and lumber products. Types of Construction: Timber piles, and timber decks. Berths: 18, length from 3 to 337 m (10 to 1,107 ft); depths from 1.8 to 14.3 (6 to 47 ft); height of decks from 3 to 6.7 m (10 to 22 ft).	None	Covered Storage: 8,073 m² (86,900 ft²) Open Storage: 28,327 m² (304,920 ft²) Refrigerated Storage: No facilities available Petroleum Products Storage: 126 storage tanks with total capacity of 8,433,130 bbl.	Railroads: Served by Burlington Northern Railroad; connections to Fort Lewis via Burlington Northern Railroad line. Roads: Fort Lewis connections via State Highways 20 and 536.	Expansion plans include enlargement of dock area.
Name: Port Angeles Location: 48°07'N, 123°26'W	Type: Natural Condition: Good Cargo Handling: 2,712,182 m.t. (2,989,619 s.t.) handled in 1974	Approaches: Minimum depth 18.6 m (61 ft); minimum width 16.1 km (10 miles) Anchorages: Minimum depth 12.5 m (41 ft) Alongside Berths: Minimum depth 6.1 m (20 ft); maximum length 402.3 m (1,320 ft)	Tidal Ranges: Mean range of tide 2.2 m (7.2 ft); between MLLW and MHHW; extreme range is 4.6 m (15 ft)	Number: 3 Commercial and 2 municipal. Uses: For handling logs, lumber, plywood, newsprint, pulp, shakes and shingles, and petroleum products. Types of Construction: Timber piles, timber decks. Berths: 8, lengths from 83.8 to 402.3 m (275 to 1,320 ft); depths from 6.1 to 12.2 m (20 to 40 ft); height of decks from 4.9 to 5.3 m (16 to 17 ft).	Cranes: One electric gantry crane with 9.1 m.t. (10 s.t.) capacity; one 4.5 m.t. (5 s.t.) tracked gantry crane on pier number 1.	Covered Storage: 1,579 m² (17,000 ft²) Open Storage: 6,224 m² (67,000 ft²) Refrigerated Storage: No facilities available Petroleum Products Storage: 38 storage tanks with total capacity of 119,750 bbl.	Railroads: Served locally by the Chicago, Milwaukee, St. Paul and Pacific Railroad to Port Townsend, 30 miles away. No connection to any other tracks. Roads: Fort Lewis connections via US Route 101 and Interstate 5.	
Name: Port of Everett Location: 48°00'N, 122°13'W	Type: Natural Condition: Good Cargo Handling: 4,734,664 m.t. (5,218,986 s.t.) handled in 1974	Approaches: Minimum depth 25.6 m (84 ft); minimum width 2,286 m (7,500 ft) Anchorages: Minimum depth 9.1 m (30 ft) Alongside Berths: Minimum depth 4.6 m (15 ft); maximum length 228.6 m (750 ft)	Tidal Ranges: Mean range of tide is about 2.3 m (7.4 ft); range between MLLW and MHHW is 3.4 m (11.1 ft)	Number: 42 Uses Handling of logs, lumber and wood products, and alumina ore. Types of Construction: Timber piles and timber decks. Berths: 17, lengths from 18.3 to 228.6 m (60 to 750 ft); depths from 1.5 to 12.2 m (5 to 40 ft); height of decks 5.5 m (18 ft).	Cranes: Two 31.8 m.t. (35 s.t.) capacity gantry cranes; two 45.3 m.t. (50 s.t.) gantry cranes; one 31.7 m.t. (35 s.t.) travelling multipurpose crane.	Covered Storage: 5,295 m² (57,000 ft²) Open Storage: 16,187 m² (174,240 ft²) Refrigerated Storage: 14,158 m³ (500,000 ft³) Petroleum Products Storage: 5 tanks, total capacity of 82,015 bbl.	Railroads: Served by Burlington Northern and the Chicago, Milwaukee, St. Paul, and Pacific Railroads. Connection south to Fort Lewis is made through Port of Seattle via Burlington Northern Railroad line and on to Fort Lewis via Burlington Northern, and Chicago Milwaukee, St. Paul and Pacific Railroad lines. Roads: Fort Lewis connections via the numerous roads around port area and Interstate 5.	
Name: Port of Seattle Location: 47°36'N, 122°20'W	Type: Natural Condition: Excellent Cargo Handling: 12,929,404 m.t. (14,251,989 s.t.) handled in 1974	Approaches: Minimum depth 25.6 m (84 ft); minimum width 2,286 m (7,500 ft) Anchorages: Minimum depth: 6 m (20 ft) Alongside Berths: Minimum depth 9.1 m (30 ft); maximum length 929.3 m (3,094 ft); minimum clearance between wharves 25.4 m (83 ft)	Tidal Ranges Mean tidal range is 2.3 m (7.6 ft); range between MLLW and MHHW 3.4 m (11.3 ft); may range to 5.5 m (18 ft) with maximum tides. Generally tidal currents in harbor have little velocity, however, with a falling tide an appreciable current can be found setting Northwest along waterfront.	Number: 207 Uses: For handling petroleum products, food, lumber, waste and scrap, grain, chemicals, cement, iron and steel, machinery, asphalt and tar, radio and TV products, limestone and sulfur Types of Construction: Timber piles and timber decks Berths: 343, lengths from 5.2 to 929.3 m (17 to 3,049 ft); depths from 9.1 to 22.3 m (30 to 73 ft); height of decks from .6 to 7.6 m (2 to 25 ft)	Cranes: 12 container cranes, 6 are 46 m.t. (51 s.t.) and 6 are 33.5 m.t. (37 s.t.) capacities; 9 revolving cranes, 5 are 43.5 m.t. (50 s.t.), one is 40.8 m.t. (45 s.t.), one is 36.3 m.t. (40 s.t.), 2 are 31.8 m.t. (35 s.t.) capacities Other equipment: 16 yard tractors; 6 container stackers, 4 are 36 m.t. (40 s.t.) and 2 are 23 m.t. (25 s.t.); and one shear-leg derrick 181 m.t. (200 s.t.) capacity; 22 straddle carriers for stacking containers three high; 7 general cargo handling facilities; and 5 major container handling facilities	Covered Storage: 278,709 m² (3,000,000 ft²) Open Storage: 287,999 m² (3,100,000 ft²) Refrigerated Storage: 20,056 m² (215,880 ft²) Petroleum Products Storage 170 tanks with total capacity of 3,148,550 bbl on the main port area; 46 tanks with capacity of 309,650 bbl located on inner port area (accessible only through locks); 85 tanks with a capacity of 2,597,800 bbl located north of the main port area.	Railroads: Served by the Union Pacific, the Burlington Northern, and the Chicago, Milwaukee, St. Paul and Pacific railroads. Direct connections to Fort Lewis via Burlington Northern, and the Chicago, Milwaukee, St. Paul and Pacific Railroad lines. Roads Fort Lewis connections via the numerous roads in and around port area and Interstate 5.	

III. OFF-POST FEATURES, FORT LEWIS (continued)

TABLE III-C, PORTS (continued)

NAME AND LOCATION	TYPE AND GENERAL CONDITION[1]	FACTORS LIMITING LARGEST VESSEL	HYDROLOGIC CONDITIONS AND UNUSUAL GEOPHYSICAL CONDITIONS[2]	PIERS AND WHARVES	MECHANICAL HANDLING FACILITIES	STORAGE FACILITIES[3]	CLEARANCE FACILITIES	REMARKS
Name: Port of Tacoma Location: 47°17'N, 122°25'W	Type: Natural Condition: Excellent Cargo Handling: 6,894,753 m.t. (7,600,036 s.t.) handled in 1974	Approaches: Minimum depth 25.6 m (84 ft); minimum width 2,286 m (7,500 ft) Anchorages: Minimum depth 15.2 m (50 ft) Alongside Berths: Minimum depth 9.1 m (30 ft); maximum length 563.9 m (1,850 ft)	Tidal Ranges: Tidal range between MLLW and MHHW 3.6 m (11.8 ft); the extreme tidal range is 6.1 m (20 ft); mean range of tide is 2.5 m (8.1 ft). Tidal currents in the harbor have little velocity.	Number: 89 Uses: Handling of petroleum products, grain, automobiles, scrap steel, chemicals, produce, logs, lumber, alumina ore, rubber, molasses Type of Construction: Timber piles, timber decks Berths: 109, lengths up to 822.9 m (2,700 ft); depth alongside from 9.1 to 21.3 m (30 to 70 ft); height of decks from 3.7 to 7.9 m (12 to 26 ft)	Cranes: 9 electric traveling full-portal gantry cranes: two 40.8 m.t. (45 s.t.) capacity, one 54.4 m.t. (60 s.t.), one 40.8 m.t. (45 s.t.), two 31.8 m.t. (35 s.t.), and three 24.5 m.t. (27 s.t.); three electric traveling straightline cranes: one 54.4 m.t. (60 s.t.) and two 45.4 m.t. (50 s.t.); two 90.7 m.t. (100 s.t.) and one 31.8 m.t. (35 s.t.) floating cranes; additional heavy lift, landbased cranes up to 136.1 m.t. (150 s.t.) are available locally on a rental basis	Covered Storage: 59,800 m^2 (643,700 ft^2) Open Storage: 408,719 m^2 (4,399,560 ft^2) Refrigerated Storage: Two 4-story buildings with 52,384 m^3 (1,850,000 ft^3) of cold storage with quick freeze capability of 290 m.t. (320 s.t.) in 24 hours. Another 21,520 m^3 (760,000 ft^3) of commercially owned cold storage is available Petroleum Products Storage: 128 storage tanks with a total capacity of 3,083,300 bbl.	Railroads: Served by the Burlington Northern, the Milwaukee Road, and the Union Pacific Railroads. Switching is performed by Belt Line Railway and the Port of Tacoma. Direct connections south to Fort Lewis on Burlington Northern and the Chicago, Milwaukee, St. Paul and Pacific Railroad lines. Roads: Direct interchange connections available to Interstate 5 to Fort Lewis.	
Name: Port of Olympia Location: 47°03'N, 122°54'W	Type: Natural Condition: Good Cargo Handling: 1,103,277.6 m.t. (1,216,135 s.t.) handled in 1974	Approaches: Minimum depth 9.1 m (30 ft); minimum width 2,286 m (7,500 ft) Anchorages: Minimum depth 7.9 m (26 ft) Alongside Berths: Minimum depth 1.2 m (4 ft); maximum length 710.2 m (2,330 ft)	Tidal Ranges: Mean range of tide: 3.2 m (10.5 ft); range betweenMLLW and MHHW is 4.4 m (14.4 ft).	Number: 8 Uses: Facilities for handling logs and/or timber, 4 used for mooring company-owned equipment; shipment of general cargo by barge, and the receipt of petroleum products for fueling small vessels; one pier is not in use Berths: 10, lengths from 12.2 to 710.2 m (40 to 2,330 ft); depths alongside from 1.2 to 12.2 m (4 to 40 ft); height of deck up to 6.7 m (22 ft)	Cranes: 2 Whirley cranes 45.4 m.t. (50 s.t.) capacity with 36.6 m (120 ft) boom mounted on apron 157.3 m (516 ft) track; one crane barge mounting two 45.4 m.t. (50 s.t.) traveling Whirley cranes 118.9 m (390 ft) trackage, 30.5 m (100 ft) booms	Covered Storage: 13,935 m^2 (150,000 ft^2) Open Storage: 157,822 m^2 (1,698,840 ft^2) Refrigerated Storage: 3,871 m^3 (136,700 ft^3) Petroleum Products Storage: 19 storage tanks with total capacity of 37,850 bbl.	Railroads: Trackage from port connects with Union Pacific and Burlington Northern Railroad tracks. Direct connections to Fort Lewis is made on Burlington Northern Railroad line. Roads: Fort Lewis connections via port roads and Interstate 5.	
Name: Port of Gray's Harbor Location: 46°58'N, 123°51'W	Type: Natural Condition: Good Cargo Handling: 3,170,983.3 m.t. (3,495,352 s.t.) handled in 1974	Approaches: Minimum depth 9.1 m (30 ft); minimum width 110 m (340 ft) Anchorages: Minimum depth 9.1 m (30 ft) Alongside Berths: Minimum depth 7.9 m (26 ft); maximum length 426.7 m (1,400 ft)	Tidal Ranges: Mean range of tide at Aberdeen is 2.4 m (7.9 ft); range between MLLW and MHHW is 3.1 m (10.1 ft) although it may reach 4.3 m (14 ft) at the time of maximum tides.	Number: 5 Uses: Handling of general cargo, petroleum products, lumber, pulp, and other forest products Berths: 6, lengths from 155.4 to 426.7 m (510 to 1,400 ft); depths alongside from 7.3 to 10.4 m (24 to 34 ft); height of decks from 5 to 6.4 m (16.5 to 21 ft)	Cranes: Two 45.4 m.t. (50 s.t.) capacity gantry cranes; one 40.6 m.t. (45 s.t.) container crane, one 54.4 m.t. (60 s.t.) bridge crane	Covered Storage: 4,924 m^2 (53,000 ft^2) Open Storage: 206,383 m^2 (2,221,560 ft^2) Refrigerated Storage: No facilities available Petroleum Products Storage: 23 tanks with total capacity of 192,200 bbl.	Railroads: Served by the Burlington Northern, Chicago, Milwaukee, St. Paul and Pacific, and Union Pacific Railroads. Direct connections to Fort Lewis via Burlington Northern, and the Chicago, Milwaukee, St. Paul and Pacific Railroad lines. Roads: US Route 12 connects port area to Interstate 5, to Fort Lewis.	Wharves located at Aberdeen and Hoquaim, 3 miles apart
Name: Port of Astoria Location: 46°12'N, 123°50'W	Type: Natural Condition: Good Cargo Handling: 2,026,462 m.t. (2,223,754 s.t.) handled in 1974	Approaches: Minimum depth 10.7 m (35 ft); minimum width 152.4 m (500 ft) Anchorages: Minimum depth 6.1 m (20 ft) Alongside Berths: Minimum depth 10.7 m (35 ft); maximum length 533.4 m (1,750 ft)	Tidal Ranges: Mean range of tide 2 m (6.5 ft); the range between MLLW and MHHW is 2.5 m (8.2 ft), although it may reach 3.7 m (12 ft) at the time of maximum tides.	Number: 3 Uses: For handling of grain, logs, lumber, frozen fish, general and bulk cargo, wood pulp and paper products Types of Construction: Timber piles and timber decks Berths: 9, lengths from 129.5 to 533.4 m (425 to 1,750 ft); depths to 10.7 m (35 ft); height of decks up to 4.9 m (16 ft)	Cranes: None available in the port area; must be rented locally	Covered Storage: 23,225 m^2 (250,000 ft^2) Open Storage: 119,378 m^2 (1,285,020 ft^2) Refrigerated Storage: No facilities available Petroleum Products Storage: 34 storage tanks with total capacity of 228,300 bbl.	Railroads: Served by Burlington Northern Railroad. Connection to Fort Lewis via Portland, total distance 275 km (170 miles). Roads: Fort Lewis connections via US 30, toll bridge across Columbia River near Longview to get to Interstate 5, then north to post, total distance 180 km (112 miles).	
Name: Port of Longview Location: 46°08'N, 122°56'W	Type: Natural Condition: Good Cargo Handling: 6,983,273 m.t. (7,697,611 s.t.) handled in 1974	Approaches: Minimum depth 10.7 m (35 ft); minimum width 152.4 m (500 ft) Anchorages: Minimum depth 9.1 m (30 ft) Alongside Berths: Minimum depth 3.7 m (12 ft); maximum length 475 m (1,500 ft)	Tidal Ranges: Mean range of tide 1 m (3.3 ft).	Number: 13 Uses: Handling of general cargo, logs, wood chips Types of Construction: Timber piles, timber decks with asphalt surfacing Berths: 16, lengths from 15 to 457 m (50 to 1,500 ft); depths from 3.7 to 12.2 m (12 to 40 ft); height of decks from 6.1 to 9.1 m (20 to 30 ft)	Cranes and Derrick: One diesel electric shear-leg derrick of 544.3 m.t. (600 s.t.) capacity; one 59 m.t. (65 s.t.) crane; 5 electric full portal gantry cranes: three 54 m.t. (60 s.t.), and two 45 m.t. (50 s.t.)	Covered Storage 85,905 m^2 (924,700 ft^2) Open Storage: 182,103 m^2 (1,960,200 ft^2) Refrigerated Storage No facilities available Petroleum Products Storage: 16 storage tanks with a total capacity of 542,000 bbl.	Railroads: Served by the Burlington Northern, the Union Pacific, and the Chicago, Milwaukee, St. Paul and Pacific Railroads. Direct connections to Fort Lewis via Burlington Northern, and the Chicago, Milwaukee, St. Paul and Pacific Railroad lines. Roads: Fort Lewis connections via port area roads and Interstate 5.	
Name: Port of Vancouver Location: 45°38'N, 122°41'W	Type: River, Natural Condition: Good Cargo Handling: 2,850,753 m.t. (3,142,364 s.t.) handled in 1974	Approaches: Minimum depth 10.7 m (35 ft); minimum width 152.4 m (500 ft) Anchorages: Minimum depth 7.9 m (26 ft) Alongside Berths: Minimum depth 10.4 m (34 ft); maximum length 143.3 m (470 ft)	Tidal Ranges: Mean range of tide 0.5 m (1.8 ft); range between MLLW and MHHW 0.7 m (2.4 ft).	Number: 5 Uses: Handling of bulk bauxite, paper, petroleum products, fertilizer, general merchandise, steel, wood products, chemicals, automobiles, grain and cement Berths: 5, lengths from 143.3 to 609.6 m (470 to 2,000 ft); depths from 10.4 to 10.7 m (34 to 35 ft); height of decks from 7.3 to 10.4 m (24 to 34 ft)	Cranes: Three electric full portal gantry cranes with 45.4 m.t. (50 s.t.) capacity	Covered Storage: 37,448 m^2 (403,100 ft^2) Open Storage: 222,570 m^2 (2,395,800 ft^2) Refrigerated Storage: 1,301 m^2 (14,000 ft^2) Petroleum Products Storage: 28 storage tanks with total capacity fo 167,500 bbl.	Railroads: Port trackage connects with Burlington Northern Railroad line for direct connection to Fort Lewis. Roads: Fort Lewis connections via Interstate 5.	

III. OFF-POST FEATURES, FORT LEWIS (continued)

TABLE III-C, PORTS (continued)

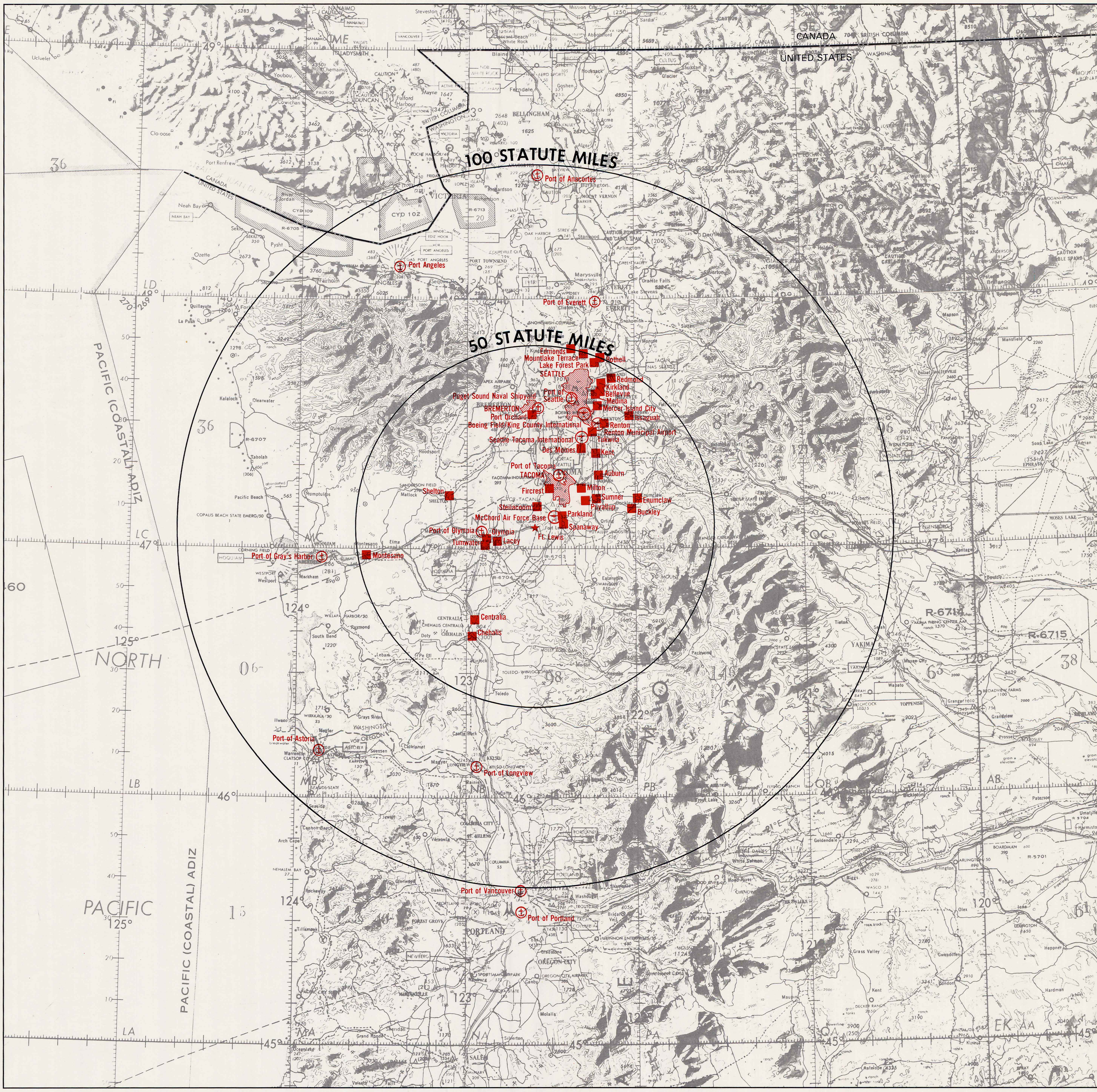
NAME AND LOCATION	TYPE AND GENERAL CONDITION[1]	FACTORS LIMITING LARGEST VESSEL	HYDROLOGIC CONDITIONS AND UNUSUAL GEOPHYSICAL CONDITIONS[2]	PIERS AND WHARVES	MECHANICAL HANDLING FACILITIES	STORAGE FACILITIES[3]	CLEARANCE FACILITIES	REMARKS
Name: Port of Portland Location: 45°31'N, 122°40'W	Type: River, Improved natural Condition: Excellent Cargo Handling: 18,843,346 m.t. (20,770,835 s.t.) handled in 1974	Approaches: Minimum depth 9 m (30 ft); minimum width 76 m (250 ft) Anchorages: Minimum depth 7.9 m (26 ft) Alongside Berths: Minimum depth 2.1 m (7 ft); maximum length 701 m (2,300 ft)	Tidal Ranges: Mean range of tide 0.5 m (1.8 ft); range between MLLW and MHHW 0.7 m (2.4 ft).	Number: 86 Uses: For handling general cargo, grain, bulk liquid cargo, coal, lumber, cement, refrigerated cargo, petroleum products, alumina and bauxite, chemicals, steel and steel products Types of Construction: Timber, steel and steel sheath piles; timber and concrete decks Berths: 106, lengths from 16.8 to 701 m (55 to 2,300 ft); depths from 2.1 to 12.8 m (7 to 42 ft); height of decks from 0.9 to 10.7 m (3 to 35 ft)	Cranes: 3 traveling, revolving full portal gantry cranes: one is 20.9 m.t. (23 s.t.) capacity with 8.2 m.t. (9 s.t.) capacity auxiliary hoist, and two are 59 m.t. (65 s.t.) capacity with 32.6 mt. (36 s.t.) capacity auxiliary hoist; one steam operated floating crane with lift capacity of 68 m.t. (75 s.t.) (numerous other floating cranes are available); one 136 m.t. (150 s.t.) electric shear-leg derrick with 22.7 m.t. (25 s.t.) capacity auxiliary hoist	Covered Storage: 235,316 m² (2,533,000 ft²) Open Storage: 549,140 m² (5,911, 092 ft²) Refrigerated Storage: 183,714 m³ (6,488,000 ft³) Petroleum Products Storage: 366 storage tanks with total capacity of 7,643,600 bbl.	Railroads: Served by the Milwaukee, the Burlington Northern, the Southern Pacific and the Union Pacific Railroads. Port trackage connects with Burlington Northern Railroad line for direct connection to Fort Lewis. Roads: Fort Lewis connections via Interstate 5.	
Name: Puget Sound Naval Shipyard (Bremerton) Location: 47°34'N, 122°39'W	Type: Natural Condition: Good	Approaches: Minimum depth 12.5 m (41 ft); minimum width 320 m (1,000 ft) Anchorages: Minimum depth 12.5 m (41 ft) Alongside Berths: Minimum depth 7.1 m (24 ft)	Tidal Ranges: Mean range of tide 2.4 m (8 ft); range between MLLW and MHHW is 3.3 m (10.8 ft).	Number: 15 Uses: Two for general purpose, one supply pier, seven repair piers and five inactive general purpose piers Berths: up to 15, lengths from 55 to 433 m (180 to 1,420 ft); depths from 7.1 to 15.2 m (24 to 50 ft)	Cranes: Mobile vehicular cranes; gantry cranes up to 45.4 m.t. (50 s.t.); 181.4 m.t. (200 s.t.) floating cranes; one fixed hammerhead crane 227 m.t. (250 s.t.) Dry Docks: 6 (see Remarks)	Covered Storage: 59,938.4 m² (548,314 ft²) Open Storage: 155,345 m² (1,672,173 ft²) Refrigerated Storage: No facilities available Petroleum Products Storage: 285,714 bbl.	Railroads: Fort Lewis connection via Northern Pacific, Burlington Northern, and Chicago, Milwaukee, and Pacific Railroad lines. Roads: Fort Lewis connections via State Route 16 south, and Interstate 5.	Contains one of the worlds largest drydocks with inside dimensions of 351 m (1,152 ft) long, 50 m (165 ft) wide at the entrance measured 1.8 m (6 ft) over sill, and 16.2 m (53 ft) over the sill at MHHW. This facility was built to accomodate the largest supercarrier.

[1]Abbreviations: m.t.—metric tons; s.t.—short tons
[2]MLLW refers to Mean Lower Low Water, and MHHW refers to Mean Higher High Water. All depths refer to the plane of MLLW.
[3]Refrigerated Storage is given in m³ (ft³), except for two ports where only m² (ft²) information is available.

FORT LEWIS, WASHINGTON

(Including Camp Bonneville, Vancouver Barracks and Yakima Firing Center)

TERRAIN ANALYSIS



Scale 1:1,000,000

20 0 20 40 60 Statute Miles

20 0 20 40 60 80 Kilometers

OFF-POST FEATURES

- ★ Cantonment Area
- Urban Area
- Airfield
- Port

Prepared by the Terrain Analysis Center, U. S. Army Engineer Topographic Laboratories, Fort Belvoir, Virginia, March 1977. Cartographic and Reproduction Support by the Defense Mapping Agency Hydrographic/Topographic Center, Washington, D. C. December 1978.

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